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September 9, 1937

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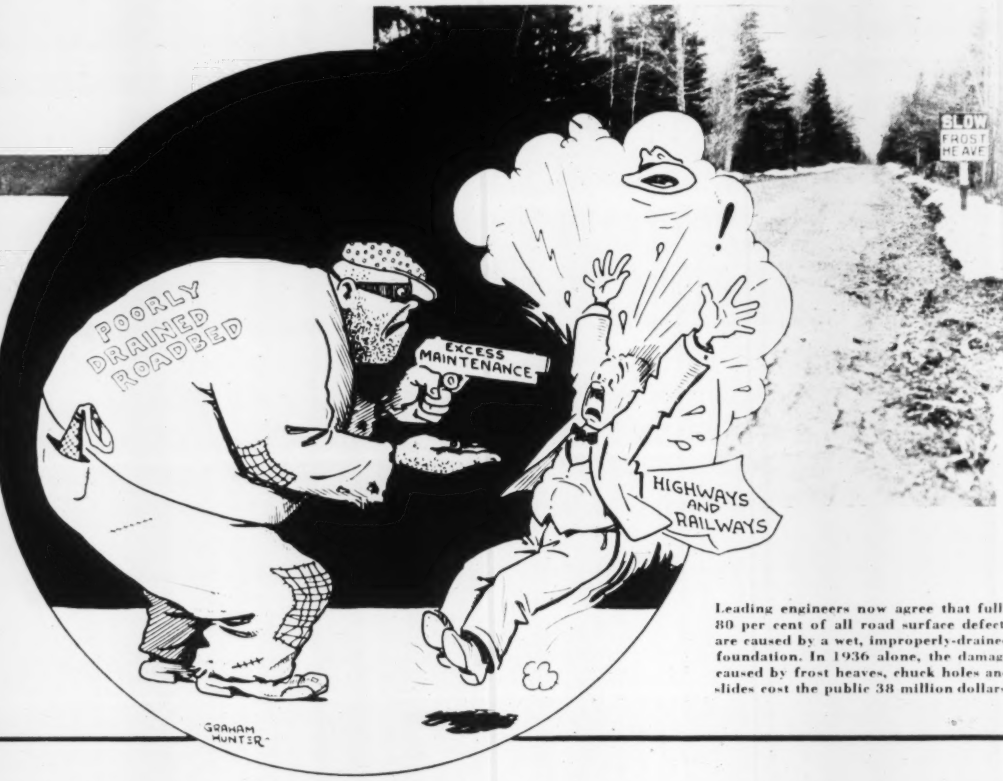

Leading engineers now agree that fully 80 per cent of all road surface defects are caused by a wet, improperly-drained foundation. In 1936 alone, the damage caused by frost heaves, chuck holes and slides cost the public 38 million dollars.

YES SIR . . . every spring you pay a heavy toll to this "Public Enemy No. 1." But don't let him bluff you. He isn't nearly as tough as he looks. Besides, there is a way to get rid of him effectively and economically.

The way lies through a *systematic* program of subdrainage. This has been proved time and again by every highway department and railroad that has adopted it. Spring break-ups have been permanently eliminated. Traffic safety has been improved and maintenance costs have been greatly reduced. One railroad, for example, *saved 14 million dollars* the first year by installing an extensive subdrainage system of Armco Perforated Pipe.

By this same method, you, too, can reduce your spring maintenance costs. Prove this fact to yourself by installing Armco Perforated Pipe under the stretches of road that are causing you trouble right now. Experienced Armco engineers are ready to give you capable and helpful assistance. Mail the coupon for quick action. Armco Culvert Mfrs. Association, 703 Curtis Street, Middletown, Ohio.

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ENR—9-9-37

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· THE PUBLISHERS' PAGE ·

To Keep Them Moving

A COUPLE OF WEEKS AGO an Associated Press dispatch announced that over the Labor Day week-end the State of Pennsylvania was to use airplanes, cruiser-cars and radio to keep traffic moving safely. The planes were to advise broadcasting stations as to the location of traffic jams and this information was to be broadcast to motorists, warning them of congested highways and indicating less traveled routes. The State Commissioner of Motor Police, moreover, was quoted as emphasizing the slogan "not less than thirty and not more than fifty," as a reminder alike to the speeder and the "road-mope." By the time this appears in print we shall know more about the success of this program.

About the same time the *New York Times* published a letter that complained of slow moving trucks. The writer suggested that no truck be licensed unless it could negotiate maximum grades with full load at a speed of not less than 25 miles per hour. Another reader protested such a requirement as being impractical and inefficient in design and operation. He inclined more favorably to what he described as "a current movement to obtain legislation requiring that all new equipment be designed to negotiate a 4 per cent grade at a minimum speed of 20 miles per hour with capacity loads." This 4 per cent ability factor, he said, "has the backing of leading truck designers, transportation engineers, safety engineers and practical fleet operators." This correspondent further suggested a "campaign for highways of four or more lanes" which would provide opportunity to pass slow moving vehicles rather than trail behind them for some distance.

THIS WRITER has no purpose to appraise here the merits of these proposals and counter-proposals. That is a job for well-informed experts. But such items, which appear with increasing frequency, indicate a somewhat new and refreshing approach to the more and more exacting problems of highway congestion and safety. They are refreshing because they reflect a trend away from the attitude of mere restriction and repression that has prevailed so widely.

Such a trend recognizes that the function of highways is to facilitate traffic and that the essence of traffic is movement rather than stagnation. It recognizes also that the best interests of safety are served when we give first consideration to the needs and desires of the average driver rather than of those who interfere with the average either by speeding excessively or dawdling on the public highway.

Heretofore most of the regulatory effort has been devoted to curbing those who violate sound traffic practice by driving at *excessive* speeds. But little has been done about those who offend equally because of their unwillingness or inability to maintain *reasonable* speeds. Yet any observant and thoughtful driver knows that the "road-mope" and the underpowered truck upset the flow of traffic and invite motoring hazards at least as often, if not more often, than does the speed fiend.

THERE CAN BE NO DOUBT THAT, as suggested by the *Times* reader, there is urgent and growing need for the improvement of many highways in order to provide more economical and safer channels for highway transportation. Great as is that need, it is wise to recognize that the funds available for this purpose are inadequate and must be applied where they will accomplish the greatest good. Meanwhile we should strive to use most effectively the facilities that exist.

This implies moving over them the largest possible volume of traffic in the minimum of time consistent with reasonable safety. And if we are going to accomplish this, it is just as necessary for us to keep after those who obstruct the most effective use of our highway facilities by their slowness as well as those who imperil the general safety by their excessive speed.

Willard Chevalier

ENGINEERING NEWS-RECORD

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Socony Binder "C" Bituminous Macadam, Standard Brand, west of Gardner, Mass., on Mohawk Trail Route.

Socony Asphalt Road Oils · Socony Asphalt Joint Fillers · Socony Waterproofing Asphalt · Socony Cut-Back Surfacing Asphalt · Socony Asphalt Binder A for surface treatment · Socony Refined Asphalt for sheet asphalt paving · Socony Cold Patch Asphalt for all types of patching · Socony Asphalt Binders B & C for penetration work (Asphalt Macadam) · Socony Paving Asphalt 51-60 and 61-70 Penetration for the mixing method (Asphaltic Concrete) • *Specifications and all other particulars furnished on request.*

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VOL. 119 *SEPTEMBER 9, 1937* No. 11

THIS WEEK AND NEXT

FOUNDATION contractors for the Neches River bridge in Texas turned a swampy job into an all-water operation by dredging over a mile of construction canals through the salt marsh. An article in this issue covers this interesting foundation job on one of the big bridges of the year.

Another foundation article concerns a new type of pipe pile. Large increase in load-carrying capacity is obtained by extending the concrete filling of the piles into a socket drilled into the solid rock.

Zoning, like slum clearance and vacation with pay, is generally considered as an unassailable principle. When someone says that zoning is not only a failure but that it is a false doctrine—as W. L. Henderson, prominent Detroit realtor does in this issue—he deserves an audience.

Another principle—that of covering irrigation reservoirs to prevent evaporation losses—is challenged by a study made in California.

New low cost road types require new types of equipment. One article in this issue tells how a scarifier with hollow teeth is used to mix oil with a gravel sub-base. A second article presents a stimulating analysis of the new equipment needs for cement-bound soil roads.

New problems also beget new practices. To carry a water line over the Bay Bridge at San Francisco to the site of the Golden Gate Exposition required pipe joints that would take up 30-in. expansion movements. A swing pipe with interesting spherical joints was the solution.

NEXT WEEK—Preceding by a week the New England Water Works Association convention, the issue, will place major emphasis on modern water supply practice.

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THE COVER PICTURE—Driving batter-piles for the Neches River Bridge in Texas from floating equipment in canals dredged through the marshes by the contractor.

Goodbye....

TO MARKER MAINTENANCE COST

Traffic marker of Atlas White portland cement, on Wayside Drive, Houston, Texas. Contractor Gulf Bitulithic Company of Houston.

Atlas White traffic markers are permanently white . . . they last as long as the pavement lasts . . . their first cost is the last cost

YOU say goodbye to the cost of "keeping up" traffic markers when you install Atlas White portland cement markers. It's true that temporary markers will save some money on installation cost. But *from there on* the picture reverses itself.

For temporary markers, in the long run, usually cost more than permanent markers because you never have to spend a cent on permanent markers, once they are installed.

In fact, markers of Atlas White portland cement actually pay for themselves in the savings they effect. For these permanent markers are placed *in* the pavement, not on top of it. No maintenance is needed to keep them white—they are always white. They last as long as the pavement lasts. They have a permanent, dense, hard, white surface which resists staining and never fades or washes away.

Installing Atlas White traffic markers is a simple job. No costly equipment is necessary. No specially trained workmen are required. Regular crews with simple tools handle the job quickly and easily. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), 208 South LaSalle Street, Chicago.

M-15

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ATLAS WHITE PORTLAND CEMENT

FOR TRAFFIC MARKERS

· ENGINEERING NEWS-RECORD ·
SEPTEMBER 9, 1937

THE WEEK'S EVENTS

Hetch Hetchy Suit Set for October

Government contends private sale of power by San Francisco violates Raker act.

Trial of the federal government's suit to enjoin San Francisco from disposing of Hetch Hetchy power through an agency agreement with the Pacific Gas and Electric Co. has been set for Oct. 19 in the Northern California U. S. District Court. The controversy hinges around interpretation of the Raker Act, passed by Congress in 1913, which grants San Francisco certain rights in Yosemite National Park and Stanislaus National Forest for the development of water and power.

It is the contention of Secretary of the Interior Ickes that the city's present arrangement, which has been operating since July 1, 1925, for disposing of Hetch Hetchy power, is in violation of the terms of the original grant. The Raker Act states "that the grantee is prohibited from ever selling or letting to any corporation or individual, except a muncipality or a municipal water district or irrigation district, the right to sell or sublet the water or the electric energy sold or given to it or him by said grantee: provided that the rights hereby granted shall not be sold, assigned, or transferred to any private person, corporation, or association, and in the case of any attempt to sell, assign, transfer, or convey, this grant shall revert to the government of the United States."

As one of those charged with enforcing the terms of the act, Secretary Ickes has taken the position that the only alternative for the city is municipal distribution of Hetch Hetchy power. However, since the completion of the 70,000-kw. Mocassin Creek plant in 1925, municipal distribution proposals in one form or another have been defeated by San Francisco voters in four different elections, the first in 1927 and the latest on March 9, 1937. Charter amendments permitting the issuance of revenue bonds, designed to facilitate passage of municipal power distribution proposals, have also been defeated three times. In addition, the city spent $395,000 on a six and a half year valuation of the local utility distribution facilities, which was completed in 1930 and is now obsolete.

The government's suit for an injunction to restrain the city from disposing of its power through the agency of Pacific Gas and Electric Co. asks for a forfeiture of the city's rights in Hetch Hetchy Valley if violation of the terms of the grant continues. The complaint holds that the power plant is located on government land and that electric energy having an annual value of $8,000,000 is sold to the company for $2,000,000, thus damaging and defrauding the government.

The city's answer to the suit holds that the power plant is on land owned by the city and that the bulk of the land on which Hetch Hetchy and other reservoirs are located is also owned outright by the municipality. It denies that any water rights were obtained from the government, asserting on the contrary that they came from the state of California. The city alleges that power development in only incidental to water development and that its present power contract is in accord with public policy, citing Boulder Dam, the Yosemite Valley power plant and various Reclamation Bureau power projects where power is sold to corporations for resale. It points to the Turlock and Modesto irrigation districts which also use Tuolumne River water in their Don Pedro power plant, and

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San Jacinto Working At Half Strength

Water district asserts 600 out of original 1,200 men are now working.

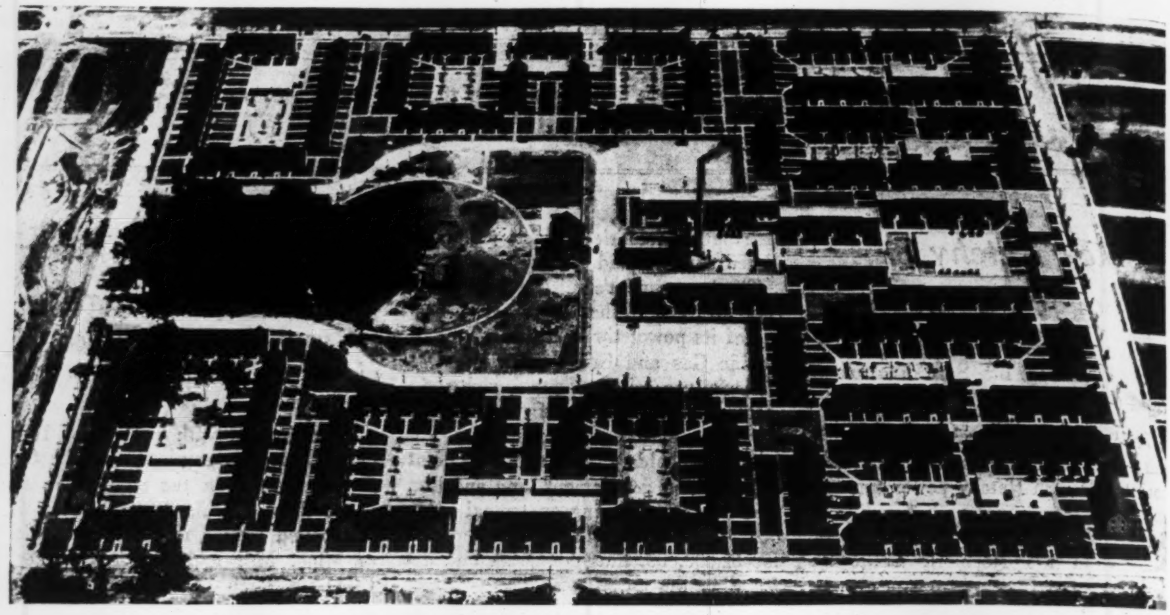
As compared with a force of 1,190 men which was employed on the San Jacinto tunnel on the day before the strike there (*ENR*, Aug. 26, p. 332) was called by the International Union of Mine, Mill and Smelter Workers, C.I.O., a force of 602 men were at work on the aqueduct Sept. 2, according to F. E. Weymouth, general manager of the Metropolitan Water District of Southern California, which is building the aqueduct. When the strike was called, Aug. 14, 206 men remained on the job. Mr. Weymouth stated that the district will continue to employ men until the necessary crews have been organized to drive the main headings on a three-shift basis. Men employed to replace strikers, he said, are not strike-breakers and it is not the intention of the district to let these men out when the strikers return to work.

According to Mr. Weymouth, the chief obstacle to further increasing the number of men working is the limited housing facilities. Before the strike few men cared to live at the camps, and since now it is impracticable for the men to go back and forth from town to the work, more housing is required.

In a communication to *Engineering News-Record*, Mr. Weymouth said the statement in *ENR* that "maintenance men are being allowed to pass through picket lines" is incorrect. He states that passage to and from all points of work for any district workers is possible only under police escort.

Hearing Postponed

The hearing which was to have been held Sept. 1, before the Riverside County Superior Court, on the granting of a permanent injunction against the striking union has been postponed, at the request of the union until Oct. 5, but a temporary restraining order remains in effect in the meantime. This order, granted Aug. 23, restrains the union from violence, mass picketing, and interference with employees of the water district.



THE AERIAL CAMERA LOOKS AT PARKLAWN

THE PATTERN of Parklawn, PWA's recently completed $2,600,000 low-rent housing project in Milwaukee, viewed from the air. The project, nearly 100 per cent occupied, provides housing accommodations for 518 low-income families. Rents start at $16.71 for a 3-room group house with full equipment and its own yard.

TVA Signs Contracts With Two Cities

The Tennessee Valley Authority on Sept. 2 announced final approval of power contracts with the cities of Trenton and Jackson, Tenn. Jackson has been purchasing power from the authority for the past year for municipal purposes, and the new contract provides for power for retail distribution. The city voted last March to acquire a municipal distribution system.

Another large power sale contract has also been negotiated by TVA with an electrochemical industry. Under the terms of an agreement announced Aug. 31, TVA will supply all the energy, up to a maximum of 40,000 kw., for the construction and operation of an electric furnace plant to be built in the vicinity of Wilson Dam by the Electro-Metallurgical Company, a subsidiary of the Union Carbide & Carbon Corporation. No transmission is involved, as the company will accept delivery at the boundary of the Wilson Dam reservation.

The contract is for a term of 20 years, but it carries a cancellation clause permitting the company to abandon operations in the area on one year's notice after the expiration of five years. Construction of the new plant is to be started before March 1, 1938, and delivery of power will begin not later than January 1, 1939.

The contract also carries a prohibition against the resale of power by the company and a guarantee that should TVA make more favorable terms with any competitor of the company, engaged in the production and sale of similar products, rates in the present contract will be scaled down.

• • •

Smaller New Jersey Canal Is Under Study

The U. S. Engineers, acting in accordance with a resolution of the Senate Committee on Commerce of December, 1936, is beginning an investigation of a canal across the state of New Jersey, connecting the Delaware River with New York Bay, with a view to determining the advisability of constructing a waterway smaller than those considered in previous adverse reports on such a project.

As a result of data presented at a public hearing held last July at Philadelphia, the special board has tentatively decided to report on the basis of a canal with a depth of 14 ft. and a bottom width of 150 ft. This canal, with a length of 29 nautical miles, would reduce the waterway distance from Philadelphia to New York, which is now 241 nautical miles, to 82 nautical miles. In conjunction with the Chesapeake and Delaware Canal, the distance from New York to Baltimore would be reduced from 418 nautical miles on the outside route to 177.

Work to Start Soon On Central Valley

Negotiations with the Southern Pacific Railroad for the removal of tracks in connection with the Central Valley project, in California, have taken a hopeful turn. There is now reason to believe that the work of removal can begin before Nov. 1. An expenditure of $20,000,000 is involved.

Final authorization of the $170,000,000 project was granted when the President, Aug. 27, signed the Omnibus Rivers and Harbors Bill of 1937, which authorizes the expenditure of sums previously appropriated in other bills. Expenditure of $12,500,000 was authorized; this sum was appropriated in the Interior Department supply bill which was signed early last month. In addition, an unexpended balance on last year's appropriation gives the project $22,500,000 to finance the work.

Work has already started at the Friant and Kennet Dam sites, where camps are being constructed to house workers on the job.

• • •

Delaware River Tunnel

A plan to tunnel the Delaware River has been disclosed at Wilmington with the filing of a corporation charter for the Delaware River-New Jersey Tunnel Company. Further details about the tunnel have not been made available.

THE CURRENT TREND

This week's news of contract volume and construction cost factors

ENR VALUES

Index Base	1913	1926
Construction Cost (Sept.)...	243.95	117.27
Construction Volume (Aug.)	150.	66.

THIS WEEK'S FIGURES

(Thousands of Dollars)

CONTRACTS

	Week Ending Sept. 10 1936	Sept. 2 1937	Sept. 9 1937
Federal	$11,036	$8,535	$2,982
State & Municipal	16,339	20,776	18,140
Total public ..	$27,375	$29,311	$21,122
Total private.	7,844	12,314	15,746
TOTALS	$35,219	$41,625	$36,868

Cumulative
1937 (36 weeks)................$1,753,990
1936 (37 weeks)................$1,613,236

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

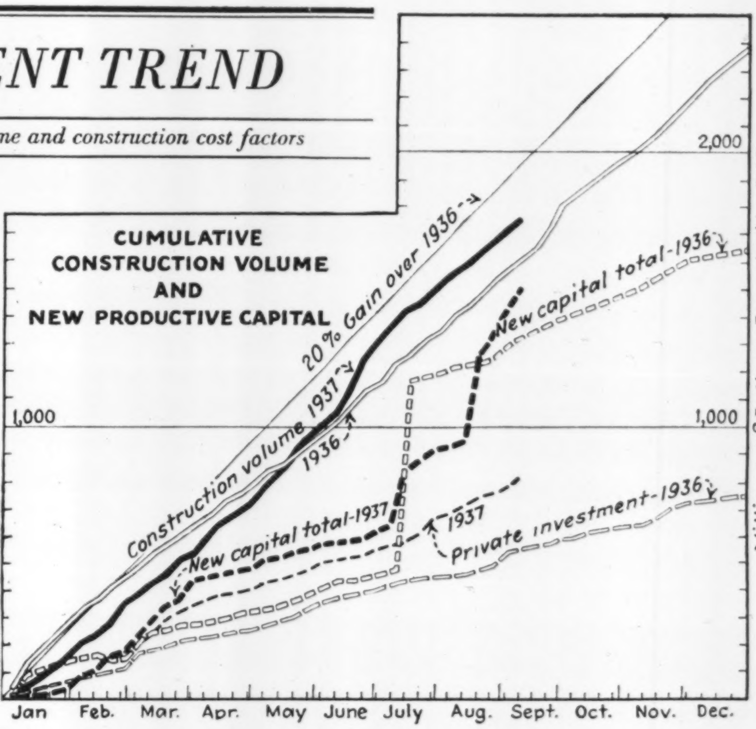
	Cumulative 1936 37 Wks.	1937 36 Wks.
NON-FEDERAL	$634,423	$1,209,289
State & mun. bonds	353,843	383,041
Corporate securities..	200,377	439,496
PWA loans, grants..	55,205	156,819
RFC loans	24,998	29,939
Fed. aid for highways	....	200,000
FEDERAL	$691,237	$416,125
TOTAL CAPITAL	$1,325,660	$1,625,414

Business Briefs

Installed cost of air conditioning equipment sold in July by members of the Air Conditioning Manufacturers' Association totalled $7,508,778, an increase of 52.1 per cent over the corresponding month in 1936. July sales topped every month last year and brought this year's 7-months' total to $68,306,175, 37 per cent higher than the 12-month volume for 1936.

Mortgage loans for construction, purchase, refinancing and reconditioning of American homes in June by all active savings, building and loan associations in the country totalled $80,500,000, as reported to the Federal Home Loan Bank Board. This is a new record for the eighteen months in which these data have been collected, and is 40 per cent above June, 1936.

The American Appraisal Company Construction Cost Index Average for 30 cities for July is 185, a 1-point increase over June. This represents a 14 per cent increase over their value for July, 1936. The year's increase, July to July, ranges from 6 per cent in Baltimore to 23 per cent in Minneapolis. Of the 22 cities reported individually, 7 show building cost rise of 14, 15, or 16 per cent according to this index.



THE MONTH'S SCOREBOARD

CONSTRUCTION VOLUME

Construction Volume (Thousands omitted)	August 1936	1937	% Change	8 months 1936	1937	% Change
Total..................	$192,317	$170,068	−12	$1,540,287	$1,675,497	+12
Private................	41,455	66,419	+60	405,467	809,858	+105
Public.................	150,862	103,649	−31	1,134,820	865,639	−22
Federal................	56,372	19,794	−64	227,599	134,332	−39
NEW PRODUCTIVE CAPITAL						
Total..................	$61,513	$408,166	+563	$1,255,037	$1,325,983	+ 6
Private Investment.....	38,528	92,302	+140	497,781	768,088	+54
Federal (non-fed. wk.)..	23,015	54,864	+138	66,019	296,838	+350
Federal (fed. wk.).......	......	261,000	....	691,237	261,057	−62

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	Sept. 1936	1937	% Change	Change Aug. to Sept. 1936 Sept.	Aug.	%	1937 Sept.	Aug.	%
EN-R Construction Cost Index '13=100......	208.10	243.95	+17	208.10	208.10	0	243.95	242.95	+0.3
	EN-R 20-CITIES AVERAGE								
Common Labor.........	$.569	$.673	+18	$.569	$.569	0	$.673	$.668	+0.7
Skilled Labor...........	1.159	1.369	+18	1.159	1.159	0	1.369	1.369	0
Bricklayers	1.206	1.459	+21	1.206	1.206	0	1.459	1.459	0
Struct. Ironworkers......	1.218	1.413	+16	1.218	1.218	0	1.413	1.413	0
Carpenters.............	1.054	1.235	+17	1.054	1.054	0	1.235	1.235	0
Cement, per bbl........	$2.58	$2.53	−2	$2.58	$2.59	−.3	$2.53	$2.54	−.3
Struct. Steel, Pittsburgh..	1.90	2.25	+19	1.90	1.90	0	2.25	2.25	0
Sand, per ton...........	1.20	1.21	+1	1.20	1.20	0	1.21	1.16	+4
Lumber 2 x 4 Fir, per M.	33.59	37.23	+7	33.59	33.14	+1	37.23	37.42	−.4
Lumber 2 x 4 Pine, per M.	30.79	32.93	+7	30.79	30.79	0	32.93	32.84	+.3
Brick, Common, per M..	13.86	14.33	+3	13.86	13.89	+.4	14.33	14.27	+.3

MATERIAL SHIPMENTS

	August 1936	1937	% Change	July 1937	% Change July- Aug.
Lumber (% 1929 wk. av. Shipments) N.L.M.A........................	63	69	+10	71	−3
Steel A.I.S.I. (% Operating capacity)..	73.5	84.2	+15	80.5	−5

	July 1936	1937	% Change	Seven Months 1936	1937	% Change
Cement (Bur. of Mines) Shipments, Bbl.................	11,823	12,237	+4	59,046	64,775	+10
Fabricated Struct. Steel Shipments* A.I.S.C., Tons......	155,124	144,560	−7	847,368	924,616	+ 9

* Subject to revision.

Auditorium Repair Asked of WPA

Atlanta applies for WPA project for repair of collapsed auditorium roof

A formal request for WPA aid in the repair of the public auditorium which collapsed Aug. 22 (*ENR*, Sept. 2, 1937, p. 375) has been made by Mayor Hartsfield, acting at the request of the city council. The application was made after negotiation of an agreement between the Mayor and Col. O. K. Yeager, WPA director of building operations, who is representing the administration on the spot. Under the agreement, WPA agrees to furnish unskilled labor and materials at an estimated cost of $23,000, and the city will supply plans, supervision, and skilled labor, which is expected to come to about $10,000. Repair work on the auditorium is expected to take about 60 days.

The Atlanta city council voted to pay $1,950 to the non-partisan board of engineers which was appointed to determine the cause of the collapse and which reported that failure of steel joists was the cause. The payment is to enable the committee to make an investigation of the entire auditorium and make recommendations as to what changes, if any, should be made in it. The money is to be taken from a sum of about $8,000 which is still owed to Dillon & Lewis, architects on the project, as part of their fee.

In response to inquiries from *Engineering News-Record*, Washington officials of WPA stated that their investigations had led to conclusions agreeing with those of the non-partisan investigating body as to the cause of the collapse. WPA agrees that the roof girders were apparently of defective construction and broke at the first real load. They state that there is not much action that can be taken inasmuch as the concern which manufactured the joists has gone out of business.

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Hetch Hetchy Suit Set for October

(*Continued from page 409*)

sell some of that power to utilities.

In denying that the government has any right or title to the water or power, or monies received from their sale, the city contends that its obligation to the government is covered by its annual rental of $30,000 for rights received and its total expenditure of $1,761,000 on roads and trails on government land. The city cites its total investment of $167,000,000 in water and power facilities and holds that damage to the municipality and its taxpayers will result from cancellation of the power contract. The further defense is made that if the government has any claims, it has been estopped from asserting them through the years that the agency contract has been in effect. It finally contends that the present agency contract is legal under the terms of the Raker Act.

• • •

Industrial Housing Project Contract Let

Contract for a $1,500,000 housing development at Springhill, Louisiana, two miles south of the Arkansas-Louisiana state line, has been let by the Webster Development Company of Shreveport, La., to McGregor & Pickette, Little Rock, Arkansas, contractors, and work is expected to start shortly after conclusion of a 60-day period allotted for completion and approval of plans.

The Webster Development Company is a subsidiary of the Southern Kraft Corporation and the Cross Lumber Industries, large-scale timber and manufacturing operators.

Financing of the housing development will be conducted through the insurance mortgage division of the FHA and plans for the project will be submitted at once for consideration by the division.

About 550 modern homes of three, four, five and six rooms with bath, will be erected on a 480-acre tract south of the town of Springhill for occupancy by employes of the Kraft Corporation's mill. The houses will be of frame construction, with papered walls and hardwood floors, and will be of modern construction throughout, with sewer and water service. Plans call for rental of the houses at $5 per room or less.

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Preferred Materials List Leads to Discharge

An alleged attempt to influence architects in the selection of material to be used in the public building program being carried on by the General State Authority, of Pennsylvania, has lead to the dismissal of Frank Nickles, supervising architect in the state welfare department.

It was charged that E. C. Dearing, who maintains an office in Harrisburg, represented himself as a manufacturers' agent and induced Mr. Nickles to send to architects a "preferred" list of articles to be used in the state construction work. The list included the names of numerous manufacturers, listing the products of each.

Vote Injunction Refused In Court-NLRB Conflict

The Federal Circuit Court at Wilmington refused Sept. 4 to grant the National Electric Product Co. an order restraining the National Labor Relations Board from holding an election at the company's Ambridge, Pa., plant to determine whether an A. F. of L. or C.I.O. union shall be sole representative for its employees in collective bargaining.

Some months ago the company signed a closed shop contract with the International Brotherhood of Electrical Workers, A.F. of L., and on May 27 that contract was upheld by a Philadelphia court. The United Electrical Workers of America, C.I.O., entered a complaint before the National Labor Relations Board, claiming that it represented a majority of the company's employees, that the A.F. of L. contract was signed in order to avoid bargaining with the C.I.O., and that the contract, therefore, represented an infringement of the rights of employees. The labor board, Aug. 30, ordered the A.F. of L. contract voided and that an election be held to determine which union should represent the workers. The company entered an appeal before the Wilmington Court, but that court refused to enjoin the election.

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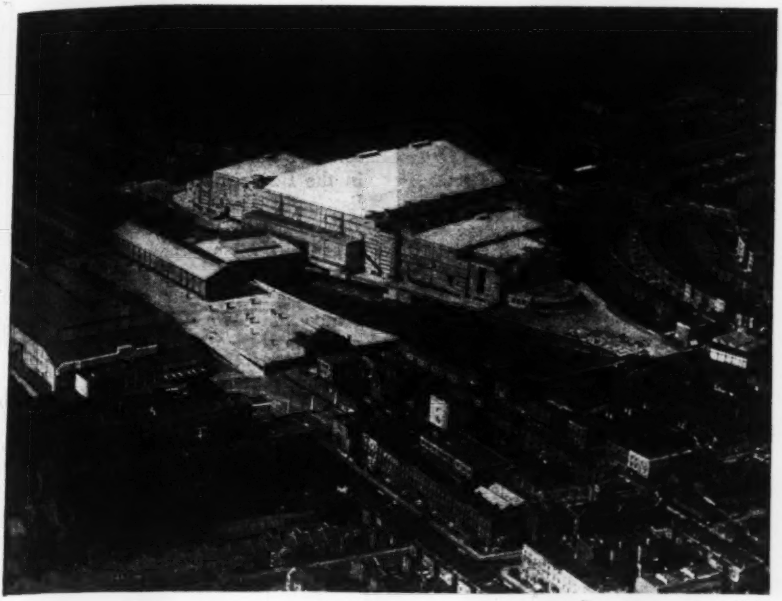
Penalty Is Contested On Coulee Pier

Hearings are now being held before the U. S. Court of Claims on a $139,000 claim of the Western Construction Co. of Seattle, based on difficulties encountered by the firm in the construction of two concrete piers at Grand Coulee dam in 1934.

The company was awarded a $180,000 contract in March, 1934, for the construction of two bridge piers, each 15 ft. thick and rising 133 ft. above bed rock. One pier was on the bank of the Columbia River and the other, which required a caisson, was offshore. Work was started April 7 and was to have been completed in 300 days. The contractor, however, required 198 additional days and was penalized $100 for each day.

At the hearings, officers of the firm have testified that they were held back on the contract work because of the unskilled laborers the government forced them to employ from the ranks of the National Re-employment Service, by delay encountered in assigning duties to such workmen, by damage done equipment by the laborers, and by the actions of government inspectors in urging workers to strike for higher wages.



Globe

LONDON'S NEW EXHIBITION CENTER

The new Earl's Court Exhibition Center, which is nearing completion in London at a cost of about $7,500,000, and which ranks as one of the largest buildings in the world, covers an area of 12 acres, and has a cubic content of 47,000,000 cu. ft. Six different railroad lines, some in underground tunnels and some in open cut, run through the site, making foundation construction difficult.

To overcome the difficulties of the problem, a series of 60 concrete underground portals were built, each bridging a railroad tunnel and providing a platform for the building. The largest of these portals is 105 ft. long. Its top consists of a block of solid concrete 18 ft. deep and wide weighing 500 tons. Construction was completed without any disturbance to the railroad traffic below. The main floor of the exposition center constitutes the largest area of concrete without expansion joints ever laid down, and the steel roof trusses which span the main hall at a height of 115 ft. above the level of this floor, are the longest that have ever been erected. Over 20,000 spectators can be accommodated around the arena, which can be used either as an exposition center or a swimming pool. By hydraulic means the floor of the swimming pool can be brought up to the main floor in three sections.

In order to maintain the same intensity of illumination in all parts of the building throughout the year, daylight practically has been excluded from the structure. The supervising contractors for the entire construction were the Hegeman-Harris Co., Inc., firm responsible for the Rockefeller Center in New York.

New Unit Replaces RA

On September 1, the resettlement administration became the Farm Security Administration, and at the same time rental rates were announced for R.A.'s new town of Greenbelt, Md., which was conceived as a model community by Rexford Guy Tugwell.

Under its new name, the Farm Security Administration will administer the Bankhead-Jones Farm Tenancy Act. Secretary Henry Wallace explained that resettlement and construction projects of the R.A. were being completed rapidly, and that future activities of that agency could not be described accurately by the word "resettlement".

The Administration has announced that rentals for the dwelling units in the new community of Greenbelt are based on an average charge of $5.90 per room per month.

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New Jersey Steel Men End Strike

A contract between the Structural Steel and Ornamental Iron Association, a contractor group, and the International Association of Bridge Structural and Ornamental Iron Workers, A.F. of L., ended a month-old strike of shop and outside steel workers Aug. 30.

The outside steel erectors went on strike Aug. 9 (*ENR*, Aug. 12, 1937, p. 251) in sympathy with the shop men.

Santee-Cooper Project Upheld by Court

Leaning largely on the recent decision of the Fourth Circuit Court of Appeals in the Greenwood County (Buzzards Roost) case, Judge J. Lyles Glenn of the U. S. District Court at Columbia, S. C., on Sept. 2 refused to grant a permanent injunction against the Santee-Cooper navigation and power project of the South Carolina Public Service Authority, beneficiary of a $6,000,000 PWA allotment.

The case was brought by the Carolina Power and Light Company, the South Carolina Power Company and the Broad River Power Company, and is one of some 60 similar actions challenging the legality of federal aid, through PWA, to public power developments competing with privately-owned utilities. Judge Glenn's decision upheld the validity of the PWA act and ruled that the damage that the utilities may suffer arises purely from competition, and is therefore not subject to equitable relief.

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Wider Traffic Lanes In California

Traffic lane widths of 11 ft. henceforth will be a minimum on new state highways in California instead of 10 ft. as heretofore, according to an announcement from the State Dept. of Public Works on Aug. 31. On four lane highways the two middle lanes will be 12 ft. and the outer lanes 11 ft. This change results from the record showing more accidents from sideswiping than from head on collisions.

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Two More California Tube Linings Complete

The placing of concrete lining has been completed in San Rafael tunnels Nos. 1 and 2 on the distributing system of the Metropolitan Aqueduct of Southern California. With the completion of the lining in these tunnels, progress summaries indicate that more than 104 miles of aqueduct tunnels have been excavated and 95 miles of these have been lined with concrete and completed. The entire aqueduct project is 65 per cent completed.

Known unofficially as Tri-city tunnels because they are located in the cities of Pasadena, Los Angeles, and Glendale, the two bores just completed have a combined length of 9,716 ft. and constitute the most westerly work now under construction on the aqueduct system. Excavation work on these tunnels was started in October, 1935.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

An increase of one-third in the personnel of the Federal Power Commission will be necessary if Congress passes the Lea bill giving the Commission the authority to regulate the transportation and sale of natural gas in interstate commerce. It is believed that the bill will pass early in the next session. At the recent session it was passed by the House and was reported favorably by the Senate committee. It was reported too late in the session to be reached before adjournment. It occupies a favorable place on the calendar. If allowed to come up in the regular course it should be reached early in the session.

Field work in connection with the survey of the Cabinet Gorge power site will be pushed as rapidly as possible before bad weather sets in. An appropriation of $25,000 was made at the last session of Congress to estimate the cost of the dam and to make a study of the market for the power. It is known that principal reliance will be placed upon developing a pumping load for irrigation. The site is a very attractive one. It is on the Clark's Fork River almost on the Idaho-Montana line.

It was incorrectly stated in these columns in the issue of August 26, 1937, p. 334, that "an act directing the Corps of Engineers to investigate the feasibility of the Cabinet Gorge project was signed by the President August 17." The act authorizes the Secretary of the Interior to make the investigation mentioned.

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Electricity Shortage Seen By Power Commission

Predicting that "power of the federal and public and privately owned power projects now constructed or in process of construction will not . . . be adequate to meet the demands in the next five years." The Federal Power Commission announced September 1 that production of electricity for public use in the United States reached the record total of 117,994,000 kw.-hr. during the year ending July 31, 1937. This represented an increase of more than 11,000,000 kw.-hr. over the year ending July 31, 1936. These figures do not include power produced by street and interurban railways, electrified steam railroads and miscellaneous federal, state and plants.

A JACKHAMMER CREW DIGS IN

To form the anchorage for the concrete arch dam of the Danville hydroelectric power plant in Virginia, these men cut steps in the solid rock of the gorge above the falls of the Dan River. PWA has alloted $2,941,000 for the construction.

N. Y. Civil Service Group Chartered by F.A.E.C.T.

The civil service section of the New York chapter of the Federation of Architects, Engineers, Chemists and Technicians has been chartered by the national office as the New York Civil Service Chapter 23. Action in granting chapter status to the section was taken because of its recent rapid growth.

At the same time, the national office announced that part of the funds granted to the federation by the C.I.O. to aid in the present organizational drive had been allocated to the new Chapter.

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National Railway Company Organized by the French

Six big railway systems of France will be merged under plans for the National Railway Company, decreed by the French Cabinet August 31. The state will hold 51 per cent of the new company's stock. It will try through the reorganization to reduce the annual railway deficit of five billion to six billion francs.

The principal railways involved are: the Nord, Est, Paris-Orleans, Paris-Lyons-Mediterrane, Midi and Alsace-Lorraine.

Toll Revisions Considered On California Bridges

Rates of toll charged on five vehicle bridges near San Francisco are now undergoing investigation in one form or another. The only toll bridge in the Bay region not included in this list is the San Francisco-Oakland Bay Bridge which is operating on the 50-cent toll basis established Feb. 1, 1937.

On August 27 a new California law became effective declaring all privately owned toll bridges in the state to be public utilitites. On that day the California Railroad Commission began an investigation to determine whether the tolls charged on several privately owned highway toll bridges "were, are, or for the future will be unjust, unreasonable, or unduly discriminatory". The structures included in this investigation are the Carquinez, Antioch, Dimbarton, and San Mateo-Hayward bridges.

The Antioch and Carquinez bridges are owned by the American Toll Bridge Company; reports indicate that the Carquinez Bridge is now operating at a profit and that the Antioch Bridge shows a loss. The two bridges on the south arm of the San Francisco Bay (Dumbarton and San Mateo-Hayward) operating more or less in competition and separately owned, are reported to be losing money.

Since the recent ruling of the California Railroad Commission allowing the automobile ferries on San Francisco Bay to reduce fares to 30 cents per automobile, the Golden Gate Bridge and Highway District has asked the Commission for a rehearing of that ruling, claiming that the ferry rate cut has diverted 16 per cent of the traffic across the Golden Gate Bridge. "There is every possibility" the petition said, "that the diversion of this traffic will result in a bridge deficit which will have to be met by the taxpayers of the bridge district."

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Mulholland Memorial Planned

A committee of Los Angeles citizens has been organized to plan a fitting memorial to William Mulholland, builder of the Owens River Aqueduct, who served the city for nearly half a century developing its water supply. The memorial will be an illuminated fountain at the site of the old Mulholland homesite near the intersection of the Los Feliz Blvd., and Riverside Dr. The property now belongs to the city Park Department. A Mulholand Memorial Fund is being created through the contributions of citizens.

News Continued on page 444

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Better Building Practices

Sir: I was very much interested in reading Mr. Seelye's article, beginning on page 93 of the July 15 issue. He speaks with authority and I heartily agree with his comments on the abuses prevalent in the investment building industry. My thirty-odd years of experience with the inspection of building construction and with the testing of materials shows clearly the woeful lack of knowledge on these subjects on the part of architects, engineers, builders, supply dealers and the average city building inspection departments. The wonder exists that there are not more failures like the one which is the subject of Mr. Seelye's article.

The owner is frequently to blame for shoddy building construction in bringing pressure to bear on everyone down the line to get the construction finished quickly and with the least possible expense to himself. And how about the financial institutions which permit their money to be used for such purposes? This kind of construction could not be accomplished without their knowledge and consent. Why not indict them as well as the owner of architect, engineer, builder, inspector or material supply dealer? They are equally guilty.

The average owner, I believe, feels that the technical side of a building operation will be properly looked after once he has placed it in the hands of the average architect, and here is where the sellout begins. Few architects are competent structural engineers, and, in order to save a part of their fee, many of them will not employ one. Fewer architects still are competent judges of materials or construction. Agencies exist for furnishing adequate, independent proof of performance on specialties and materials, and also for providing a competent, disinterested, experienced inspection of construction, and the architect who does not avail himself of these safeguards is at fault. He should impress his owner with the fact that these costs are legitimate costs of construction, and that they should be paid for by the owner.

Many architects do specify protection of this character but some of them pass the cost to the contractor who then goes shopping for the service. Unfortunately, he can always find someone who will do a thing for a price. The money might better be saved.

On the other hand, there are architectural firms who watch this matter very carefully. They insist with their owner that engineering inspecting and testing are legitimate construction costs. They pick an agency in whom they have confidence, and insist that that agency do the work, and at a decent fee, which permits the said agency to do the work properly, in accordance with the ethics of the engineering profession. So long as we have the other kind of architects in responsible charge of building construction, just so long will we continue to have "jerry-built" buildings.

Pittsburgh, Pa.
August 9, 1937

A. R. Ellis
President, Pittsburgh
Testing Laboratory

Unbraced Building Columns

Sir: Elwyn E. Seelye's timely article in the July 15, 1937 issue forcibly presents the lesson taught by the Mosholu Parkway building collapse in 1936 and proposes solutions to the problem. All of the defects listed and illustrated by Mr. Seelye have been more or less frequent practice in similar structures, and some combination of them may account for the collapse. However, the evidence is not entirely clearcut. For example, if the wall bulged as suggested in Fig. 2, page 94, the front bearing wall and tower would have had a tendency to fall outwardly. All the indications are that the collapsed structure fell inward.

Looking for a cause for such a collapse, attention is directed toward the slender 6-in. steel columns supporting the 16-in. wide-flange girder, bolted through angle clips to the column flanges. Study of this detail lends weight to a suspicion that it may have contributed to the failure. The columns were braced in the weak direction by wood joists, 9 in. deep on a 22-ft. span. There is sufficient evidence to lead the writer to believe that this framed steel bent was of insufficient strength to support the permanent eccentric dead loads, not including the additional load of brick and other construction materials stored on the roof. If these columns twisted or buckled, or if the girder connections failed, the resulting thrust or pull on the front wall might well cause a collapse of the front wall with a tendency for the superimposed structure to fall inwardly.

On the other hand, the wall was unquestionably defective. The use of a 12-in. vertically continuous curtain wall between the piers, unless the piers are designed of the required thickness and strength for isolated members, is bad practice. Considered as a bearing wall, the equivalent total percentage of opening was nearly 70 per cent of the cross section as compared with a permissible 45 per cent under the old building code and 50 per cent under the new code. Tests of the masonry taken from the walls, however, developed compressive strengths considerably in excess even of the maximum reported stress of 1,000 lb. per sq. in. at the top story windowhead.

As to ways of safeguarding the public from accidents in building construction, standards of good construction can be strengthened and many evil practices eliminated by the legal expedient of requiring all buildings involving structural design to be erected under the supervision of a licensed professional engineer who shall also have been responsible for the design. This procedure would also be beneficial in eliminating a practice of many owners and builders of depending upon the city plan examiner to check and in extreme cases even to dictate the structural design in certain classes of work. Eventually it may become necessary to restrict by law all building operations to builders who are qualified by examination and license to build. In the writer's opinion, this step need not be taken if the other procedure is made legally mandatory. Unfortunately, the new New York building code requires this only in the case of reinforced concrete buildings within which controlled concrete is used.

Such a safeguard would also remove unfair criticism from the city building department. The building commissioner acts under the police power of the state to prevent evasions of the complex building code in new work, and, by occasional examination of existing work, to maintain its structural integrity in so far as he is able. He should be no more criminally responsible than the police commissioner in exercising his function of preventing evasions of the criminal law. Nevertheless, he has been so charged under the assumption that he has technical responsibility for the structural design. Having performed his legal duty to the best of his ability, the plan examiner of the building department should neither be required to assume responsibility nor be held criminally liable for the design of defective structural details and certainly not for failures of improperly executed field work.

New York, N. Y. — George E. Strehan,
Aug. 30, 1937 — Consulting Engineer

Sir: The writer feels positive that this accident was not due to the failure of the steel bent supporting the rear end of the tower girders, as suggested by Mr. Strehan. His reasons for this, though conclusive, are too involved to be entered into in this letter. It is sufficient to say that the columns were braced by steel as well as by wood and showed no buckling in the plane of the bent, such as would be the case if the seat connections had induced eccentricity.

As the slender columns now in use are under suspicion by engineers, it is of great value to have the subject brought up. Is our column formula too bold? Do practical considerations, such as columns bowed in shipment or loose bolting which fails to provide restraint to neutralize the eccentric effect of seat connections, tend to render these light columns particularly dangerous? Should we require all steel columns to be braced with steel? These are important questions.

The masonry sample taken from the wall by a defendant, as referred to by Mr. Strehan, was more than thirty days old, capped with reinforced concrete and thus did not represent conditions under the girder at the time of the accident, when the mortar was still very green.

The writer agrees with Mr. Strehan that a licensed structural engineer should be in charge of both design and erection. There has been a great deal of inexplicable beating about the bush on this point by self-appointed guardians of public safety.

If you are going to shoot a bear you use a rifle. If you are going to prevent building accidents use a structural engineer.

New York, N. Y. — Elwyn E. Seelye
Aug. 31, 1937 — Consulting Engineer

Let the Citizens Speak

Sir: Reading of the timely articles by E. G. Plowman (ENR Aug. 5, 12, 19) on that live subject of waterworks management, leaves with me the following impressions and thoughts:

(1) The management of a publicly-owned water utility reflects the general character of the citizens of the community, i.e., the management of the utility is as good or as bad as the community itself. Using the author's figure of speech, "Johnny" probably will not develop into an upstanding man unless he has an upstanding father and mother.

(2) I am not a 100 per cent advocate of independent board and commission management of publicly-owned water utilities. Such boards and commissions have their proper place in the management and control of water districts made up of several municipalities, such as the Boston metropolitan district or the East Bay district. But for the ordinary independent municipality, I believe a certain degree of municipal control of the water utility must prevail in order to properly coordinate the management of this activity with other municipal services such as waste disposal, sanitary and health control, power and lighting service. These are all very important activities of a municipality, each one practically as important to the community life as the other.

I have great faith in the judgment of the citizens and believe the best administration of municipal affairs will be secured if we do not remove the management of the citizen's affairs too far from him. We should see that Mr. Citizen has at least a remote control of his affairs. He likes it that way and is willing to pay the additional cost involved.

Kenilworth, — C. M. Osborn
Illinois — Village Manager

Defends WPA Picketing

Sir: Your letter of Aug. 5 to Albert H. Ortmann, in which you state "That the Federation of Architects, Engineers, Chemists and Technicians has not been free from the mob spirit is only too evident in recent happenings in the WPA offices here in New York," has been called to our attention.

We protest this vicious characterization as unjust and dictated in the interests of the employers group. Your evident support of this group will deserve the alienation of the technical employee. We shall assuredly do our utmost to contribute to such alienation unless your statement quoted above is retracted in full, and the technical employee given at least that impartial consideration which you attempt to convey.

We demand specific instances in which our activities, according to you, are exhibits of "mob spirit." If you have reference to any of the activities of the WPA technicians who conducted mass meetings and picket lines in protest of their dismissals, we should like to acquaint you with the elementary fact that such activities are entirely within legal limits and within their democratic rights. It is only such organized action that will prevent the inhuman and callous discharge of large numbers of workers without the contingency of mass jobs being available.

In the face of these conditions, to maintain that technical employees have a professional responsibility that must cause them to look upon unionization with disfavor is attempting to pull a blind over the eyes of these employees. Professional responsibility and empty pockets cannot feed technicians, and it is indeed encouraging to note that the trend of the technical employees in relation to unionization is in the direction taken by skilled workers, who through successful organization have been able to increase their standards. To call upon technical employees, as you have done, to beware of unions as rackets and exploiters, while at the same time attempting to present your advice as impartial, is a fraudulent practice on your part devised definitely to give aid to the employers group by alienating the employees toward unionization. Unless your vicious and unwarranted statement against our organization, expressed in your letter to Mr. Ortmann, is publicly retracted, we shall feel obliged to undertake more stringent action.

New York City, **HARRIMAN H. DASH**
Aug. 12 1937 Acting Exec. Sec.
WPA Section, N. Y. Chapt.
Federation of Architects and Engineers
Chemists and Technicians.

[Our statement referred to happenings at the WPA offices. —EDITOR.]

To Unify the Profession

Sir: James J. Martin in your July 29 issue says: "There are bar associations and medical associations. Why should there not be an engineering association?" Of course, the answer is, there should be.

What is needed by the entire engineering profession is a nationwide association of engineers, devoted exclusively to the work of promoting the economic and professional status of all engineers.

Fortunately the organization is already in existence and functioning efficiently. With 22 years of experience the American Association of Engineers stands ready to serve engineers in the way that they need most at this time.

It is rather amazing that so many engineers realize the great need for just such an organization and yet seem unaware of its existence. It is equally amazing that thousands of engineers who are somewhat familiar with the work being done by the Association do not sufficiently recognize the value of this work and the necessity for it to support the Association by their membership.

Los Angeles **WILLIAM C. HOGOBOOM**
Aug. 12, 1937 President
American Association
of Engineers.

Unsafe Bridges!

Sir—In a letter on "Rot in Bridge Timbers" (*ENR* Aug. 5, 1937, p. 213) it is stated, in connection with the collapse of an old bridge in San Benito County, Wash., that timber of box-heart cut was used whereas side-cut timbers are now recommended by the lumber interests to reduce checks, increase service life, etc. No matter of what materials constructed, all structures are subject to deterioration and require periodic and intelligent inspection and care to avoid serious trouble and expense. In the bridge collapse above referred to, it was admitted "the structure had little or no maintenance during its entire life" and, from experience, I should add that it probably had as much inspection.

If the condition and existing reasonable capacity of thousands of such old bridges were determined, the information posted and the limits enforced, the general public would experience a considerable shock, but the value of a bridge as an important link in the highway system would be forcibly brought home. Instead of facing this issue squarely, however, most public bodies continue to play "ostrich," stick their heads in the sand and refuse to admit the condition. As a result the public continues to use these structures with full confidence and in sublime ignorance of the hazards. These public bodies thus assume, in the name of the people, the liability of suit in the event damage and casualties result. It is true that no large percentage of collapses has as yet occurred, but to any one dealing with this subject, it should be evident that more and more such accidents will occur. This is more likely to happen now than it has in the past due to the extremely large increase in the weight and speeds of present day vehicles.

California began some 8 or 10 years ago to do something about these old structures by setting up a special department charged with determining the current condition of all structures at all times. This is a necessary and logical setup to supply information for biennial budgets, and to indicate the weak links in the road system thus permitting the most economical placing of funds to the end that maximum use may be had from the roads. Special "check calculations" have been developed which deal specifically with older structures, and posting is done in a thorough and reasonable manner.

It would be interesting to know just how many states or other public bodies, have taken up this problem.

In California, the State Department of Public Works is obliged by law to make examinations and submit an engineering report recommending the safe live load that may use a structure. This liberal law has been taken advantage of by a few of the counties of the state but the percentage is not what it should be considering the general situation. The larger counties and cities, with well organized engineering departments are giving the matter proper attention but many others are doing nothing about it.

Sacramento, Calif. **M. H. GODWIN**
Aug. 16, 1937. Bridge Department
Calif. Dept. of Public Works

Dynamite Brought It Down

Sir: Referring to your article "Bridge Engineer's Odyssey" (*ENR*, July 15, 1937, p. 109) in connection with the old timber bridge at Orford, please permit me to correct the information given you regarding the demolition of the old bridge, namely by burning over the center pier.

While spending my 1936 vacation at Lake Morey at Fairlee, Vt., I became very interested in damage to bridges throughout the New England States, and visited a great many along the Connecticut River. A few days after my arrival at Lake Morey, I heard about the Fairlee-Orford bridge and soon made the acquaintance of the field superintendent of the Littleton Construction Co., which had the contract to build the temporary timber trestle downstream from the old covered bridge, and also the demolition of the covered bridge.

The demolition of the covered bridge was accomplished by placing charges of dynamite in the top and bottom chords so as to cut the chords on each side of the center pier, dropping the two spans into the river. Eight charges of dynamite were used and fired at one time. It was a pretty shot. The New Hampshire side span fell intact, the shore end tipping on the abutment with the center end resting in the river at the base of the center pier. The Vermont side span fell intact until the center hit the river bed and then broke at a point at the shore line. After trying to salvage the timber from the old bridge, it was found to be an endless task so it was set afire and all above the water was burned.

Balboa Heights, C. Z. **GEO. W. GREEN**
Aug. 12, 1937 Municipal Engineer
The Panama Canal.

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SEPTEMBER 9, 1937

SUITABLE EQUIPMENT for stabilizing soil base and foundation for road surfaces is lacking. All highway engineers who have given testimony on stabilizing experience have voiced this lack and it is emphasized in the account in this issue of road base stabilization with portland cement. This construction was carried out with standard earth moving and other common roadbuilding machinery, as have been all other stabilizing operations except where suboilers have within two or three years been used for stabilization with asphalt. By a chance of scheduling, the suboiler is illustrated and its operation is described in another article published this week. The suboiler is unique in being, today, the only special equipment designed for soil stabilizing operations. Is there not opportunity for equal specialization in equipment for applying cement, salt, calcium chloride, lignite or other stabilizing agents? Soil stabilization in roadbuilding has come to stay and the equipment engineer has a vital part to play in hastening its wide adoption.

Useful Work

GOVERNMENT SUBSIDY is found in one of its best forms in the allotment of $22,000,000 by the PWA for the rehabilitation of defective or dangerous school buildings. This allotment will provide safety and better sanitation where they are most needed, namely in schools, which in spite of large recent expenditures for improvement still include many buildings far below any tolerable minimum standard. Second in importance but of no mean value is the effect of the allotment in reviving the building industry, which has seen less recovery than other industries and therefore has not contributed its full part to reemployment. As a matter of fact schools are no worse but on the contrary much better than other public institutional buildings—which in their proportion of "slum" structures are probably at as low a level as city housing. But schools obviously have first claim to rehabilitation. Therefore if it is necessary to continue public expenditure in aid of recovery our school plant is an excellent place for this expenditure. By using part of its remaining funds for this useful work, the Public Works Administration has shown that it knows how to combine promotion of recovery with other public interests no less important.

The Road Back

MANY ESTIMATES have been made of the total number of homes that must be built each year before the housing situation will be even reasonably satisfactory. Huge national totals, however, are difficult to comprehend and even now the serious nature of the housing shortage is not generally appreciated. A special survey of the building permit situation by the Bureau of Labor Statistics is therefor welcome. Unfortunately the survey covers only the 1929-1935 period, but it is broken down into reports on specific cities so that the statistics are of more comprehensible scope. Take Toledo, for example. In the 7-year period, permits were issued for 1,822 family units, but 65 per cent of these were in 1929. The succeeding years were almost barren of building and, worse still, in the four years, 1932-1935, there were 300 more buildings demolished than were built. Memphis, Tenn., tells the same story. Of the 2,484 permits, nearly 1,900 were issued in 1929 and 1930. In 1934 and 1935 demolished buildings exceeded new construction by 110 family units. Even if twice as many buildings were built in 1936 as in 1935, which is the national ratio, Memphis and Toledo remain badly underhoused. As reports are released on other cities, the picture will merely be broadened, and will not be changed. The fact is that the road back is still largely ahead of us. And for this reason, if no other, homebuilding and its allied construction operations should be expected to accelerate to boom proportions before another year has passed.

Cost Engineering

COST ENGINEERING is as old in practice as is construction for profit; its recognition as a studied art, however, carries back no farther than the beginning of the century. Even today only a few builders admit that there are scientific laws of construction management. For this reason the article by H. P. Maxton in last week's issue does a needed service in reaffirming vital principles. It deserves consideration for emphasizing the distinction between costkeeping and bookkeeping, if for no other reason. The one is a system of showing in money values the efficiency of workmen and machines; the other is merely a means for showing debits and credits. And, finally, the chief value of the article is its emphasis on costkeeping as only the means to an end. The means are the daily records of work accomplished in terms of time and money; the end is economy of labor and materials by scientific study of cost reports and time records of performance. This study and the application of its lesson in reforms of construction practices is cost engineering—and there is no more profitable employment of engineering talent in the field of construction.

Complete the Job

Roadbuilding today is never complete until the pavement is bordered by smooth, firm shoulders. This doctrine has received universal acceptance, and its importance is proved by scores of discussions of shoulder construction and shoulder maintenance. Why, then, does the road traveler find many miles of neglected shoulder or, better said, no shoulder at all? The only possible reason is the desire of highway officials to stretch a given expenditure over the maximum mileage even at sacrifice of safety and efficiency. No such reason can be justified in these times, no matter how valid it may have seemed a dozen years ago. We know too well that rough and soft shoulders cause accidents and that by forcing traffic over to the centerline they also reduce capacity. Roads with inadequate and dangerous shoulders should be completed without delay in the interests of road transport as well as of public safety.

White-Elephant Airports

Hundreds of cities throughout the country are in a dilemma over their airports. Having spent large sums of their own money and, more recently, of federal relief-work money, they find that their airport facilities still are inadequate, prospectively if not actually. Two or three years hence, it is predicted, planes will weigh 20 tons instead of 10; they will take off faster; they will land blind, on flatter angles; they will have wider wing spreads; they will come in and take off more often and with more passengers. But will they? And if they do, where is the money coming from to pay for these airports of the future? These are the horns of the dilemma which are prodding city officials and airway authorities alike, because it is recognized that most of our present airports are white elephants, providing no return on the investment and giving only mediocre service to the airplane.

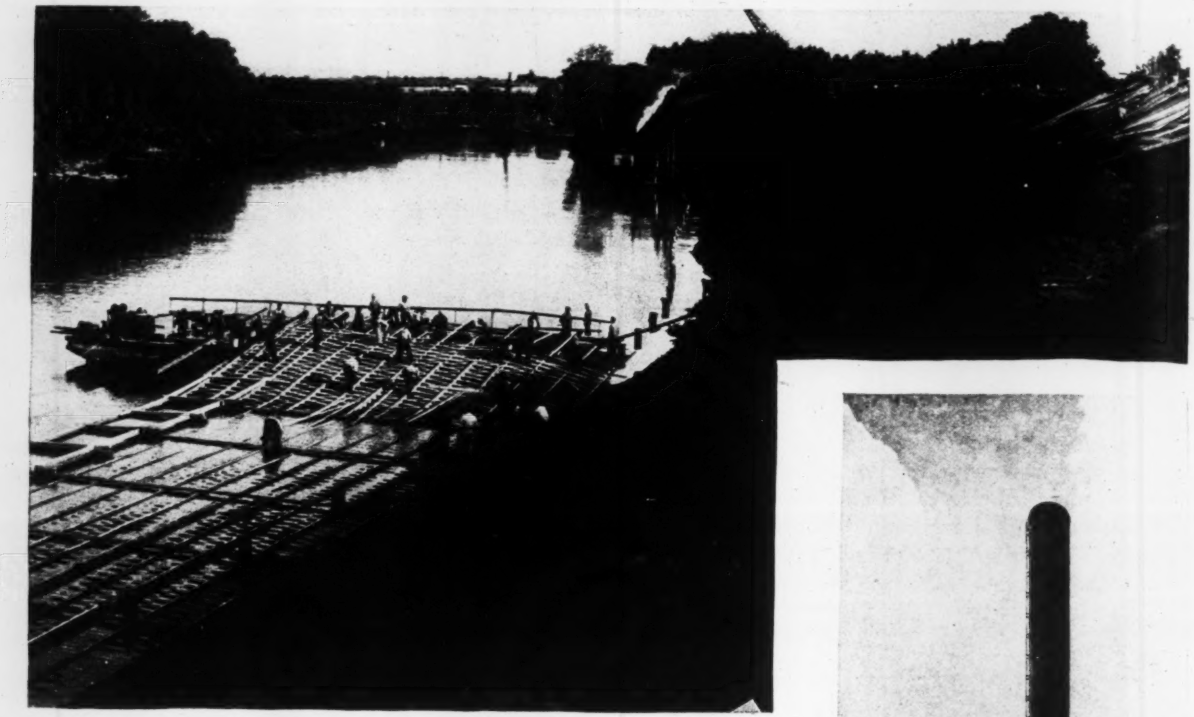
First is the problem of design, not only of single airports but of an airport pattern. The U. S. Bureau of Air Commerce has developed specifications for various classes of airports, which are indispensable, but no one has yet said what type of port Youngstown, Ohio, or Butte, Mont., for example, is justified in going into debt for. Every city cannot be on a transcontinental line or even on a first class branch line. To date, however, few cities know where they stand in this respect, and consequently they must gamble every dollar put into airport facilities. Some authoritative body must soon draw up an airline pattern that will be reasonably permanent, so that cities will have a basis for intelligent planning.

But planning is only the beginning of the design, and past records of design performance are not impressive. Some of the inadequacies of present airports—hangars that are too small and runways that are too short, poor passenger facilities and breakable drainage structures—are due to inability to predict the plane of the future, and this difficulty still persists. Other design shortcomings arise, however, from poor planning. For example four of the largest airports in the world—Newark, Croydon in London, Le Bourget in Paris and Tempelhof in Berlin—are being extensively remodeled because, for one thing, the necessary addition of more land has left the airport buildings in the center of the field. In other cases proper provision was not made for plane movements on the ground or for motor vehicle circulation from or into adjacent highways. Essentials of design are not well understood and here, too, a guiding hand is necessary. Probably it is available in the Bureau of Air Commerce, but even the specifications of that bureau apparently need some overhauling. At present they go only part way in solving the cities' dilemma over what and how to design.

And when and if a satisfactory design procedure is evolved, who is going to pay for the expensive facilities that will be necessary? The cities having already invested some $400,000,000 are frankly expecting help. Two bills were introduced in the last Congress inviting federal assistance, and state governments have been importuned to aid. Inasmuch as Congress gave waterways to ships, rights-of-way to railroads and highways to motor vehicles, it will be expected to do more for air travel than it has already done by its airways marking program. From the standpoint of either interstate commerce or military demands, airport building is a national job for which city, state and the federal government will each have to assume its share of responsibility. The airlines, too, should bear a share of the burden.

One comes to a single conclusion: the cities' dilemma is a national dilemma. It must be solved by nationwide attack, with federal leadership and federal financial aid, but with joint responsibility on the part of states and cities fully recognized. Given an airline pattern as a basis of planning, a set of essential and farsighted specifications as a basis of design and an intelligent joint financing plan, proper airport development will be assured. Lacking any of these essentials, the present white elephants not only will be perpetuated but more will be built.

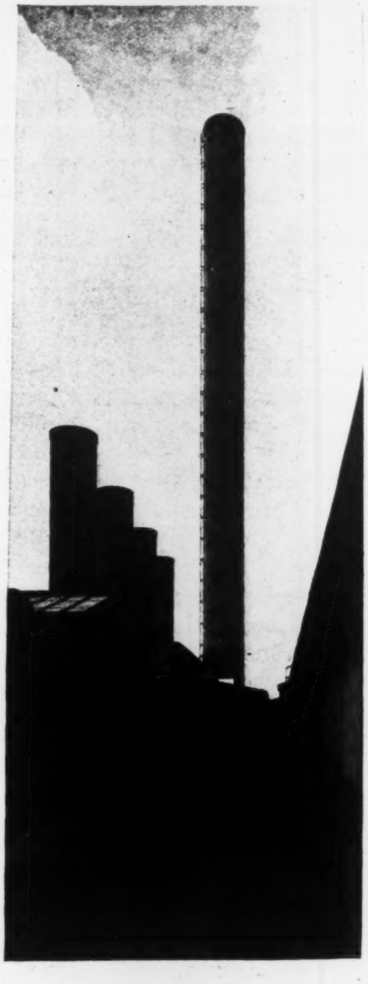
PICTURES IN THE NEWS



BUILDING BOARD MATTRESSES along the Sacramento River which, like the Mississippi and the Missouri, is the scene of continuous flood control work. Headwater control, as at Ft. Peck, is also on the books for the Sacramento in its Kennett Dam.

Photo by Louis Seidman

TUNNEL BUILDER'S VIEW of the sky above New York City's Delaware Aqueduct, currently under construction.



LARGEST all-welded stack goes into service at Fisk Station of Commonwealth Edison Co. at Chicago. T-section butt straps are a unique feature of the design.

Unusual Foundation Plant for Long Bridge

Ingenious piledriver, dredged canal for construction access, and deep sand islands for small piers are features of substructure work for Neches River bridge

THE LARGEST highway bridge in Texas and one of the largest in the South is being built over the Neches River, near Port Arthur, where the stream traverses a wide expanse of salt marsh on its way to Sabine Lake and the Gulf. The structure, an important link in the Hug-the-Coast Highway along the Gulf, eliminates an inadequate ferry across the river near its mouth, and is financed largely by the state, though Jefferson County and the PWA are also contributors. Topographical and climatic conditions at the site are of such nature as to pose a peculiar problem of foundation design and construction. The solution is of interest, especially from a construction standpoint, as an unusual array of plant and equipment has been developed to cope with the swampland conditions of the coastal plain.

Long approaches required

Though the river is only 1,000 ft. wide at the location of the bridge, two miles above the mouth at Lake Sabine, the bridge is 7,700 ft. long as a result of long approaches required at either side of the 400-ft. navigation channel which had to be crossed with a clearance of 176 ft. In ancient times the swamp was a part of the much larger Sabine Lake; now it is a soft muck 35 ft. deep, topped by a vegetable mat only a foot or two above river level, and incapable of supporting any appreciable load, such as construction equipment.

The bridge consists of a 680-ft. cantilever center span to provide 600-ft. clearance between fenders, flanked by 374-ft. through-truss anchor spans, and deck trusses, deck girder and concrete slab approach spans. Located in the tropical hurricane belt, the bridge is designed for an unusually heavy wind load, 75 lb. per sq. ft., in transverse, longitudinal and diagonal directions. The wind load is carried down to the foundation by spread steel towers. On the center span the spread is 110 ft. though the trusses are only 34 ft. apart; the spread lessens as the approaches drop in height on a 5 per cent grade.

The center, anchor and deck truss spans are carried by eight pairs of circular caissons, 18 to 32 ft. in diameter, sunk about 100 ft. through muck and sand to a hard clay (Fig.

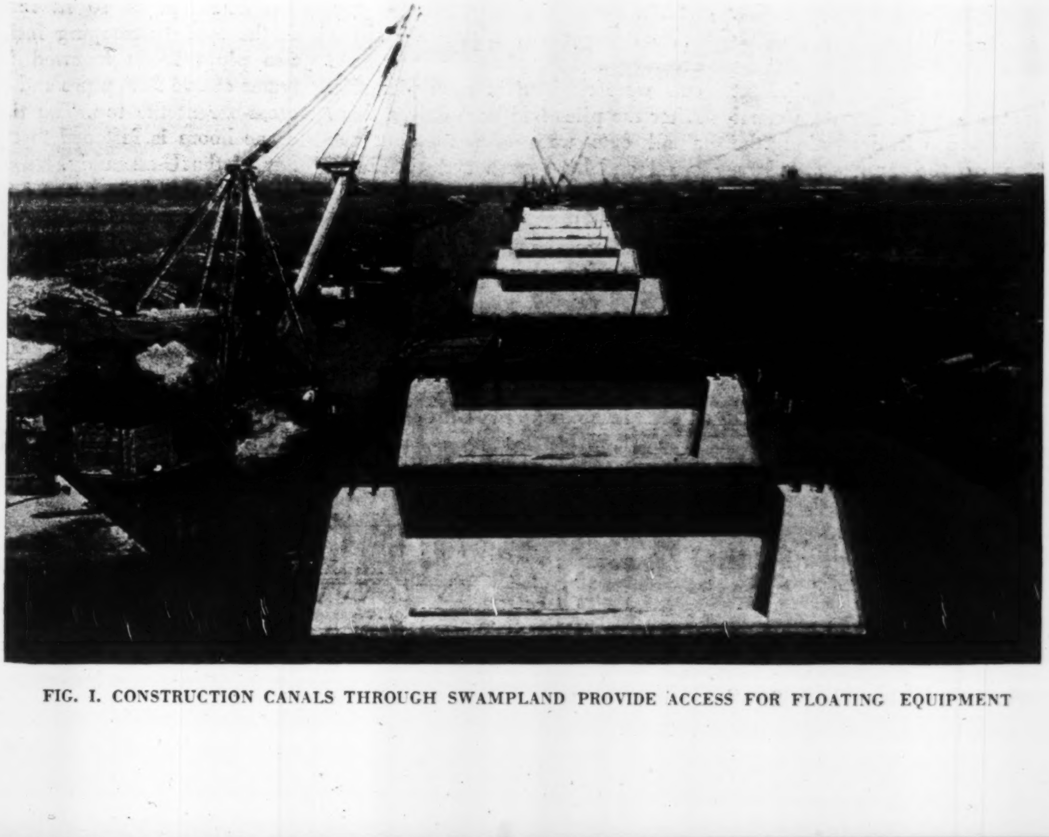


FIG. I. CONSTRUCTION CANALS THROUGH SWAMPLAND PROVIDE ACCESS FOR FLOATING EQUIPMENT

2). For the other towers and bents, the foundations are low concrete piers or pedestals supported by a total of 1,600 untreated wood piles (Fig. 3.) The caissons are deep enough to withstand the horizontal wind stresses, but the piers and pedestals depend upon numerous batter piles to take the wind load. Because of the large number of batter piles to be driven, the contractor developed an ingenious and unusual driving rig, which will be described later.

Job for floating plant

Access for equipment and transportation of construction materials to the various parts of the job, especially to the approaches that extend for more than half a mile on either side of the river, was the chief problem confronting the foundation contractor. A sand spoil bank along the south side of the river, deposited from channel dredging operations several years ago, fortunately provided access by land from the ferry landing on the old highway to the river crossing. Thus it was possible to reach the center of the job with cars and trucks. However, the two sets of main span caissons are in the river, and all of the approach foundations are practically inaccessible by land, since road-building across the swamp because of excessive cost was out of the question. The foundation job was logically one for floating plant.

To provide for floating equipment the first step was to excavate a canal 60 ft. wide and 5 ft. deep along the west line of the approach piers, starting at the river (Fig. 1). This required a dredged cut 3,600 ft. long to the south and another one 3,400 ft. to the north. These two canals were dug by a heavy crawler crane, mounted on a barge and equipped with a 2-yd. dragline bucket.

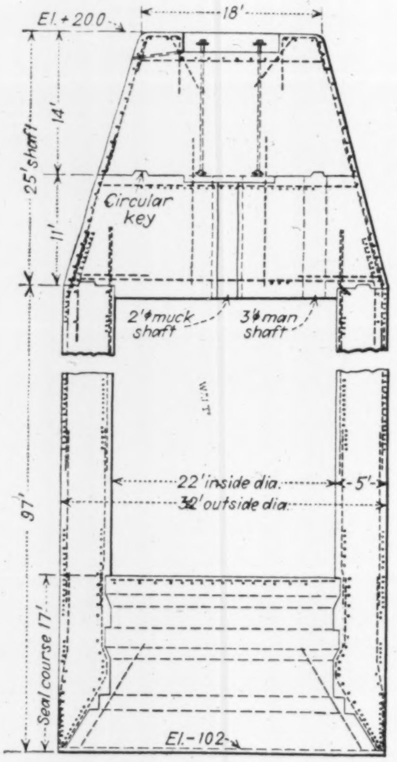


Fig. 2. Cylindrical caissons like this were sunk 100 ft. through sand islands; main sinking was by open dredging, landing on hardpan; sealing was under air.

Near the river, where the spans are long and the piers far apart, side cuts were dredged at each pier site. After the piles had been driven these small cuts were closed off at the canal end by a mud box cofferdam to permit the piers to be built in the dry (Fig. 4). Further back from the river, where the piers are close together for the short spans, the canal was widened out a section at a time and a mud box cofferdam was built to inclose a group of several piers.

Versatile pile driver

Driving of 1,580 piles, from 70 to 86 ft. long was the major feature of the foundation work. About half of the sticks are Douglas fir, shipped by rail from Oregon, the remainder are Southern pine from nearby sources. All were delivered to the pier sites in rafts. Few of the piles were driven vertically; most of them are on a batter to provide lateral stability to the piers in the soft muck.

Because so many of the piles were driven on a batter in all directions, the approach subcontractor developed a clever pile driving rig that is quickly adjustable to any driving angle or position. The power plant consists of a large steam whirler crane mounted on a 40x56 ft. barge. Outrigger pontoons were added at the sides to give the barge greater stability. Projecting over one end of the barge are two steel A-frames that support an 18-in. horizontal pipe beam built up by welding to 1½-in. wall thickness. A pair of steel leads, 85 ft. long, is supported about midpoint on the back by a spool roller riding on the pipe cross-bar. Near the top of the leads on their back side are welded in vertical position two 10-in. pipes 10 ft. long, open at the top. Telescoping inside these two pipes is an inverted U-shaped frame of two 9-in. pipes and a welded cross-bar at the top. The tip of the crane boom is fastened to the cross-bar of the U-assembly.

By swinging the crane and booming up or down the leads can be tilted to any driving angle. There is no strain on the leads, for the top

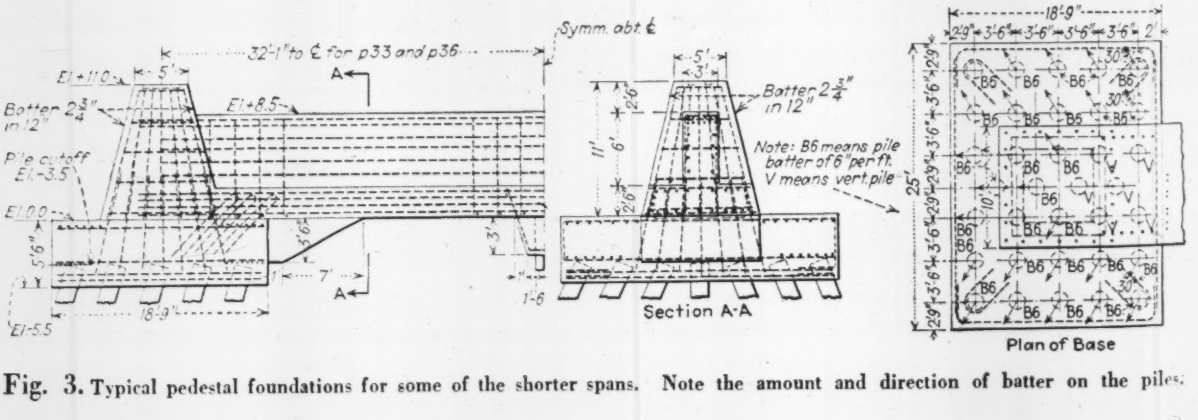


Fig. 3. Typical pedestal foundations for some of the shorter spans. Note the amount and direction of batter on the piles.

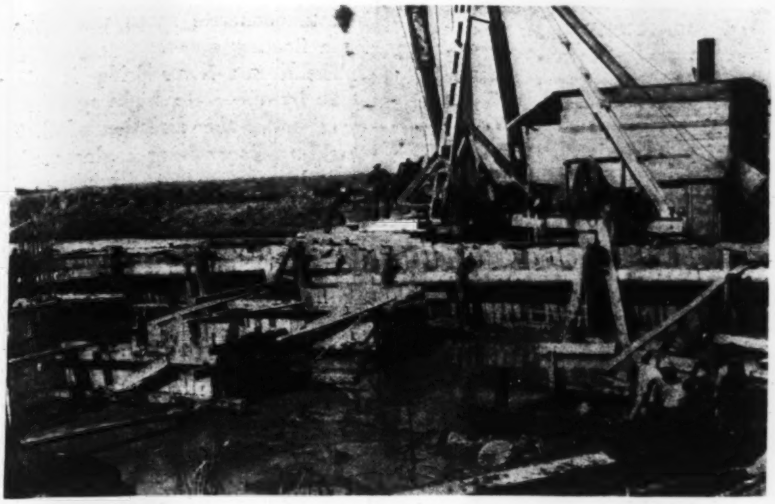


Fig. 4. Side cuts from the canals were closed off by timber and mudwall cofferdams to permit building of the pier caps in the "dry," though, as this view shows, it was usually a sloppy mess far from dry-bottom.

pipe assembly slides up and down within the pipes welded to the leads, and the conical roller acts as a pivot. The leads are pulled back and forth across the large pipe by an auxiliary engine operating through a cable and pulley arrangement. Thus the leads can be spotted anywhere along a 40-ft. front and can be tipped to any desired driving angle. The leads overhang the bars far enough to permit tipping the bottom towards the rig. Views of this unusual driver are shown in Figs. 5 and 6.

Piles were delivered to the driver lashed together in small rafts. All piling was driven through the muck and sand formations to the clay. Usually the lengths were such that the piles struck refusal when the tops were just out of the water, but occasionally the big type 5,000-lb. double-acting super steam hammer followed the pile down into the water. The piles were cut off to grade (El.—3.5) after the cofferdams had been built and the pile area unwatered.

Sand island caissons

The sixteen circular caissons required for the heavier spans were all sunk within artificial sand islands. The caissons varied from 18 to 32 ft. in outside diameter and were sunk to about 100 ft. below water level.

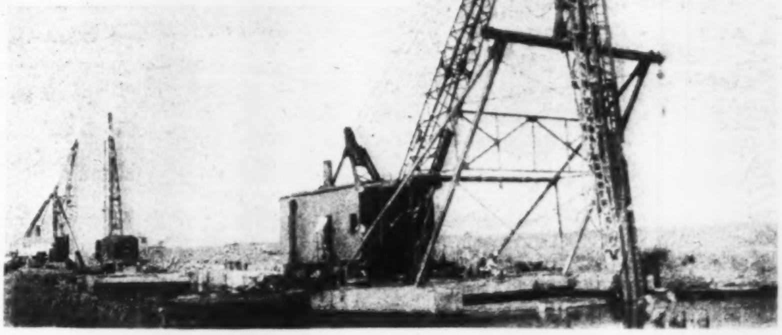


Fig. 5. Crane-controlled leads are pivoted on an overhanging A-frame for driving piles at any desired angle. The entire rig is mounted on a barge steadied by outrigger pontoons.

At each caisson site a cylinder of 45-ft. arch web steel sheeting was driven in a circle 10 ft. greater in diameter than the outside of the caisson. The muck within the sheeting was dredged out to a depth of 30 or 35 ft. and the cylinder was then backfilled with sand.

On top of the sand island was set a short steel cutting-edge section, upon which was built the first concrete lift for the caisson. This and the succeeding lifts were built up within steel forms. The caisson walls, 5 ft. thick for the larger sizes, 4 ft. for the smaller, are heavily reinforced. Sinking of the caisson cylinders was by the open dredging process; the interior muck was removed by clamshell as the caissons went down. Jetting around the cutting edge aided in sinking the cylinders.

The caissons were sunk by open dredging as deep as possible, usually through the sand to the clay (Fig. 7). Then a conical concrete cap with air locks was built at the top and compressed air, as high as 48 lb. pressure, was used for the final few feet of sinking well into the

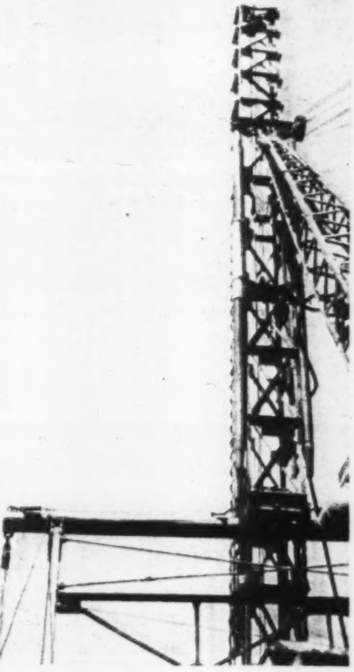


Fig. 6. Back view of the piledriver leads showing the telescoping pipes that fasten the leads to the crane boom, permitting side travel and change of batter without strain.

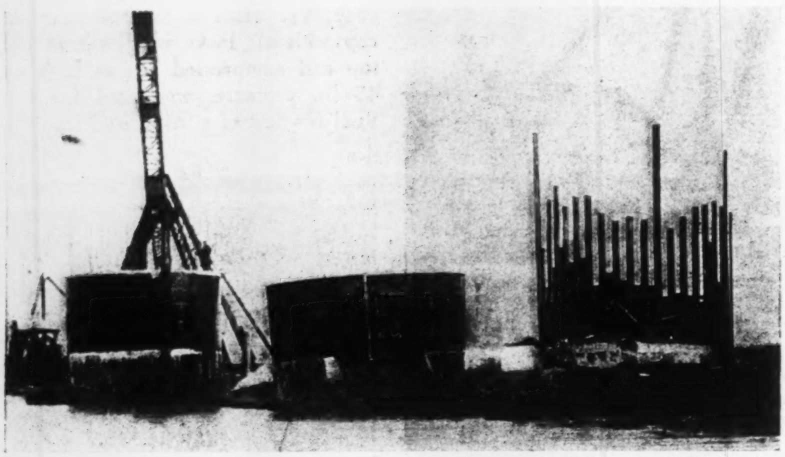


Fig. 7. Two of the caissons on their way to hardpan through sand islands and sheeting for a third island in place.

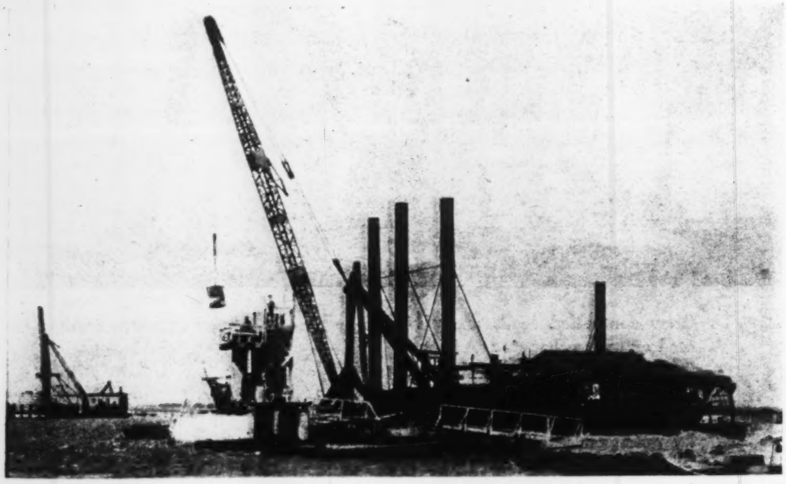


Fig. 8. A floating steam compressor plant served the caissons. Derricks for muck and concrete handling were erected on falsework.

clay, and for sealing. The seal was placed to a depth of 17 ft. in the dry. Except for the seal, the interiors were not filled with concrete, but were allowed to fill with water after completion.

Sand hogs are scarce in Texas, so it was necessary to import practically all compressed air workers from St. Louis and Chicago. A floating change house was provided for the men, equipped with lockers, lunchroom and a medical lock.

A large steam-operated stiffleg derrick carried on falsework served each pair of caissons. Floating cranes of various sizes assisted in handling materials for the caissons. The muck spoil was cast to one side clear of the river channel. Even the compressors were mounted on barges (Fig. 8). They were all steam-operated, and were served by three large horizontal boilers set on the same barge.

Concrete plant

All concrete was supplied by a central batching and mixing plant built on pile falsework near the river bank. Sand and gravel came from pits along the Trinity River near Cleveland by rail to Beaumont and thence by barge to the job. The batchers were charged by a stiffleg derrick, also on piles. Mixed concrete was dumped directly from a mixer into buckets on a small barge. A barge load of six buckets, all of the bottom-dump type, was towed to the point of placement by a small tugboat. Concrete for the caissons was handled by the stiffleg derricks at each location; that for the other piers and the concrete spans was placed by a floating crane.

The Neches River Bridge is being built by the state highway department under the direction of G. G. Wickline, supervising engineer, who is on leave of absence from his position as engineer of bridges for the highway department. P. V. Pennybacker is principal engineer on the project for the state. The structure was designed by Ash, Howard, Needles & Tammen, consulting engineers of Kansas City and New York. George E. Cole and Giles H. Edwards have served at different times as engineer inspector for PWA.

Contract for the substructure was held by the Union Bridge & Construction Co., Kansas City, Mo. C. A. Neal, president, was in personal charge and Art Sollars was superintendent. The Austin Bridge Co., Dallas, Tex., was subcontractor on the approach piers, including the foundation piledriving and the fenders around the two main channel piers. The Austin company developed the piledriving rig under the direction of J. B. Templeton, vice-president. Jos. Grace and Wm. Crabtree were superintendents for Austin. Erection of the superstructure, is being done by the Taylor-Fichter Steel Construction Co., of New York, under the direction of S. E. Kapelsohn, construction manager.

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High School Students As City Apprentices

The experiment of using high school vocational training students as apprentices in city hall is being tried in Escanaba, Mich., a city of 14,521.

Students were selected on their scholastic records, and after interviews with city manager George E. Bean. Two apprentices were placed in the city engineers' office and one in the municipal garage. They will do "laboratory work" and will receive high school credit for it. Two students who worked under the system last year are employed by the city this summer on a $50 per month apprentice basis.

Tentative plans for next year will place one or two apprentices in the water department, one at the sewage disposal plant, one in the light plant, and two or three more in the city engineering department.

Zoning Is A Failure

by W. L. HENDERSON

Vice President, Homer Warren & Co., Realtors, Detroit

City zoning practice has been harmful because of its confiscating nature and the frequency of amendments and exceptions

FOR EIGHTEEN YEARS I have asked zoning experts to point out one protective feature we would enjoy under zoning, and have received no answer. It is time, therefore, to challenge zoning. I will try to set forth its faults and its harmful effects.

Police-power zoning is wrong in principle. Yet it has happened in the United States of America—the land dedicated to freedom.

Zoning is a menace that cannot be ignored. Its professional advocates are cunning and persistent. It is an attempt to define public safety, health, convenience, comfort, prosperity and general welfare by an exercise of police power. Some people confound city planning with city zoning, whereas they are quite different; they have different origins and are based on different principles.

City planning involves planning of streets, parks, boulevards, harbors, location of business centers, etc. City planning is intrinsically American. City planning proceeds under the right of eminent domain with compensation to the property owners. Zoning on the other hand involves a great multiplication of taboos for the individual property owner, renter, builder and user. It makes property owners relinquish their property rights. It empowers a few government officials to determine the use, character of use and extent of use of each piece of property in a city.

Zoning is guesswork

One should not overlook the fact that the sales talk as to the merits of zoning is entirely different from the zoning ordinance itself. Zoning is regulation and control and confiscation without compensation. Zoning is based on the guesswork of a few individuals—no proven facts outline the zones. The decision is made by zoning officials with little or no knowledge of land economics, city growth, trends or population shifts. Zoning uses that fiction of law called exercise of police power to pave a highway bypassing the people's constitutional rights.

A practice is no better than its principle. Zoning being wrong in principle necessarily must fail or become so weakened that it does not serve any real purpose. It is, however, an additional expense to the taxpayer, owner and renter. This is now admitted by the most optimistic zoners. The secretary of the National Association of Real Estate Boards in a recent statement said, "We have tried for the last twenty years to check neighborhood blight through zoning ordinances. On the whole, however, this effort has not succeeded very well. Zoning ordinances have been weakened by being amended constantly at the request of interested persons. Amendments and exceptions have run into the thousands in the larger cities over a single decade. Thus more neighborhoods in our cities have become blighted—people have moved away." And he further states that "protection can only be assured by voluntary restrictions applied to neighborhoods."

Zoning allows a bureau to decide the percentage of factory property, store property and homesites, allows it to mark off special districts and prescribe one set of rules and ordinances for one district, and an entirely different set of rules and precepts for another. No compensation is given for property values taken or confiscated. It is brutally disregardful of the other fellow's rights. The zoning bureau becomes the judge and determiner of real estate values.

Zoning increases rents and the cost of living. What group knows best about the real estate business and the reduction of costs—a commission of a few men giving part time to the problem, or thousands of people making these problems their own business, investing their own business, investing their own capital and under conditions of competition trying to put out their product cheaper? It is impossible for a few men to understand fully the present and future problems of a city's industry, commerce and housing.

Discriminatory features

Zoning makes building difficult and expensive. It tends to create slums rather than eliminate them. Often it necessitates holding an obsolete building on the land rather than permit natural improvement to take place. The discrimination against manufacture and business by confining them in small districts, and yet allowing these districts to be built up by houses that limit the supply of manufacturing space, leads to higher production costs.

Zoning does not provide for the growth of a city, as no zones are made outside the city limits. It just messes into the old sections of the city and disturbs existing conditions. Zoning does not classify citizens by race or color. It classifies them by the amount of money they can afford to spend to live in a certain zone.

Why should a bureau take from the people their common law right of contract? Why should you be denied the privilege of investing where the price and security suits you best? It is paternalism to assume that property owners are incapable of prudently contracting with reference to their own property without an express grant of a body politic.

Zoning assumes that the property holders are children needing the protection of a bureau in the ordinary affairs of buying and selling their property, that they have criminal intentions in the development of their property to injure their neighbor.

Reasons for failure

Zoning is a failure and a menace for the following reasons: It is political control of private property. It means control and regulation, not protection. It is a stab at all titles, since use is governed by permit. Zoning attempts to maintain the desirabilty of neighborhoods by character of buildings and number of families housed, when in effect the things that destroy the character and desirability of a neighborhood are not covered by zoning.

It is enough to name only a few of these matters that zoning does not touch. They include pets running loose that destroy shrubs and dirty up yards; dirt in the house and garage or both that attracts vermin; display by some families of the weekly wash in a way that would disgrace a canal boat; neglect of shrubs, lawns, awnings, fences; gossip; quarrels over children, lot lines, fences, hedges; uncontrolled, destructive, noisy children; trouble making neighbors; racial encroachment; parking.

And, finally, zoning does nothing to decrease the cost of building. On the contrary, it makes building costs higher, while it does not render the property more desirable or useful.

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Government to Pay for Raising Bridges

The President has signed a bill providing that the federal government reimburse owners for alterations to Columbia River bridges at Cascade Lock and Hood River which have been made necessary by the damming of the river at Bonneville. The two bridges will have to be raised to bring them above the backwater of the dam.

When the bridges were built, plans were submitted to the government for drawbridges as an alternative but this was ruled unnecessary then.

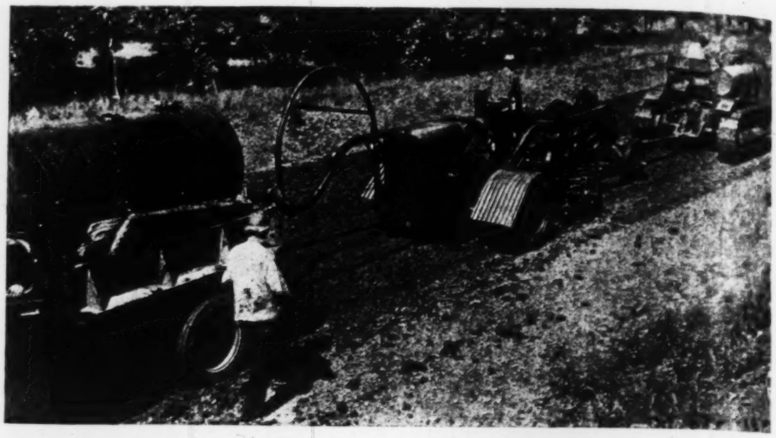


FIG. 1. SUBOILING WITH TRACTOR, OILER AND TANK TRUCK IN TRAIN

Road Patching with a Suboiler

by Edward L. Espenett

Division Superintendent of Maintenance, Missouri State Highway Dept., Kansas City.

Suboiling entirely practicable in repairing broken-down sections of stabilized soil base

Suboiling as a maintenance operation was employed in an interesting manner in repairing parts of a 13-mi. road in Pettis county, Missouri. The road was constructed in 1930-31 as a gravel road, with a 30-ft. roadway, modern drainage structures and very good alignment, both vertical and horizontal, there being only one flat horizontal curve on the entire section. The traffic averages over 1,000 vehicles per day, but of these a considerable number are heavy trucks.

In the fall and winter of 1933-34 the road was scarified, reshaped with 6 to 8 in. of crown, and gravel added where necessary to produce a wearing course of 3.4 in. of well graded clay-gravel mixture. On this base, during the summer of 1934, an oil mat surface was constructed, consisting of 1½ in. of graded gravel aggregate and a medium-grade liquid-asphalt, mixed in place after priming the base, bladed down with a motor-grader and rolled.

In the spring of 1935 a few short sections failed and were resurfaced with an additional thickness of mat. In the spring of 1936 a larger number of failures was evident and an average of $241 per mile was spent in reprocessing, resurfacing and sealing as required. In the spring of 1937 a survey revealed a progressively larger number of more serious failures, aggregating about 2 mi. of the 13. The bad sections varied in length from 100 ft. to nearly 2,000 ft. The failures were entirely in the subgrade; the so-called stabilized base had failed due to subgrade capillary moisture, heavy traffic, etc. It was then decided to use the suboiler in an attempt to stabilize the sections which had failed.

Suboiling plant and methods

As a preliminary step the bad sections were scarified to a depth of about 6 in., then 16 cu.yd. of gravel per 100 ft. were added and the whole was thoroughly scarified again. This work was done early in the spring and it was hoped that traffic would pound these sections down into an adequate base; due to a lack of binder in the gravel, this did not happen, and at the time of suboiling, a large amount of loose gravel was still in place on the roadway.

The suboiler consists essentially of a frame similar to a grader frame, on which is mounted an undercarriage carrying 32 scarifier teeth. These teeth are hollow, with a small hole in the heel of each tooth. To each of these teeth oil under pressure is forced while the tooth is in the ground. The machine is $7\frac{1}{3}$ ft. wide, the teeth averaging $2\frac{1}{2}$ in. apart. The quantity of oil applied per square yard can be controlled by maintaining a constant pressure of 40 lb. per sq.in. in the pump supplying oil to the teeth and by keeping the tractor at a constant speed of 1.9 mi. per hour by the use of a tractor tachometer.

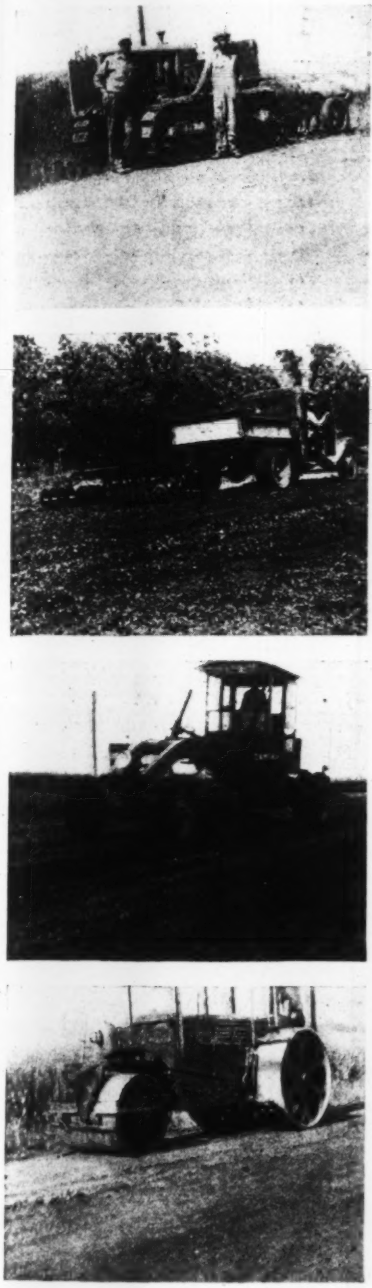


Fig. 2. **Four processes, scarifying, harrowing, blading and rolling supplement the suboiling operation.**

Fig. 3 shows the machine mounted on a trailer bed for moving from job to job. Fig. 1 shows the unit being used on the job.

The first step was to blade all loose material on the roadway and then scarify thoroughly to a depth slightly more than 6 in. with the tractor and scarifier shown in Fig. 2. The next operation consisted of blading and disking to obtain as loose a material as possible, and the most uniform mixture possible of soil and gravel, with an absence of lumps of any kind. Fig. 2 shows a tandem double disk being pulled behind a truck, and a motor grader blading and smoothing the surface.

It was decided to suboil to the scarified depth of 6 in. Allowing for the oil in the original $1\frac{1}{2}$ in. mat, computations indicated that 2 gal. per sq.yd. would be required to stabilize the required depth and this quantity was placed in two applications of 1 gal. each, the first application being placed at the full depth of 6 in. and the second application 4 in. below the surface. The oil used was a liquid asphaltic material ordinarily used for surface treatment work.

The suboiler was pulled with a 60 hp. tractor and was fed by a 500-gal. tank mounted on $1\frac{1}{2}$-ton trucks; not to impede traffic, the truck followed behind the suboiler instead of alongside. Oil was fed from the tank to the suboiler through a 3-in. hose, thence pumped under pressure directly to the scarifier teeth in the ground. Fig. 1 shows the unit in operation. The large loop shown at the rear of the suboiler is merely a piece of pipe bent to form a handy support for the supply hose. Another device that was found valuable was the connection between the suboiler and supply truck. This consisted of a stout chain inside a section of 2 in. pipe, making it impossible to damage the supply hose by pulling away from the truck, or getting too close and kinking it. This device proved its worth after a hose had been pulled apart, spraying the operators with oil. The finishing operations consisted of blading, shown in Fig. 2, followed by rolling. To aid in shaping and compacting, $1\frac{1}{2}$-gal. of water per sq.yd. was at first applied, but frequent rain during the progress of the work made this unnecessary. All work was done under traffic with only minor inconvenience to passing motorists.

As an experiment several sections were suboiled with an emulsion of a 60 per cent emulsion of 92 per cent asphaltic oil. To obtain the same asphaltic content, $2\frac{1}{2}$ gal. of emulsion were used per square yard, in two equal applications. It is believed that curing will be more rapid where emulsion is used.

Due to the depth at which the oil is placed, considerable time will be required for complete dispersion throughout the entire roadway. In the meantime occasional bladings are necessary to eliminate traffic ruts and striations of oil appearing on the surface. When complete dispersion is obtained, a thin armor coat will be placed over these sections as a wearing course.

The work was done with division maintenance forces under the supervision of the author. Rex M. Whitton is engineer of maintenance for the state highway department and Carl W. Brown is chief engineer.

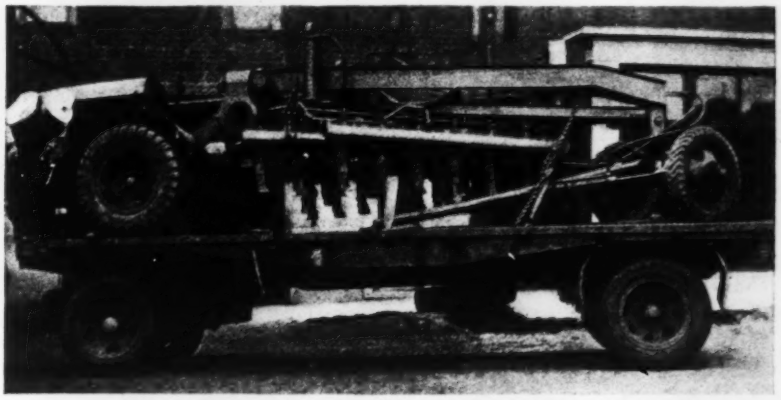


Fig. 3. **Suboilers ride from job to job on a special trailer drawn by a truck.**

Providing For Expansion in Water Mains

by A. P. Malley

San Francisco Water Department

Water mains carried on Bay bridge deck to serve Golden Gate Exposition island must be able to take up 30-in. length change

Providing adequate fresh water supply for the Golden Gate International Exposition was complicated by the fact that the location is on an island in San Francisco Bay. The site could be served to good advantage by gravity flow from a reservoir on Yerba Buena Island which rises to a height of several hundred feet above tide level, but problems arose in connection with a pipe line that would deliver water to such a reservoir. The most logical route was across the suspension spans of the Bay bridge and to operate safely there it was necessary that the pipe have numerous joints which could take up movements as much as 30 in. Moreover, there were limitations on methods of taking up this movement: neither the ordinary stuffing box nor the long-radius curves sometimes put in where there is plenty of room could be used on the bridge. A solution of the problem that is somewhat unusual, so far as the author knows, is described in the following.

Pier W-1 on the San Francisco side of the bridge was selected as the starting point for the bridge pipe line because this pier is within a city block of a 12-in. main in the network of the San Francisco water department. This main is fed in such a way that it would be feasible to supply from it the 10-in. pipe line proposed for the Bay bridge. The diameter of the pipe on the bridge, including a 2½-mi. length from the San Francisco network to the island reservoir, was fixed by the fire protection needs of the Exposition. These requirements were met by provision of a 3 million gallon reservoir on the island and a 2.5 m.g.d. capacity in the line on the bridge. The latter requirement called for a 10-in. pipe. The pumping costs for the one year the Exposition will be open were figured against the cost of a larger pipe with lower frictional losses, and the 10-in. line was the result.

The pressure at the pumping station necessary to lift the water up the pier and force it through the delivery line is about 250 lb. per sq. in. Pressures in the pipe on the bridge will vary from 50 to 150 lb. per sq. in. The pipe is being bracketed to the north side of the stiffening trusses between the upper and lower decks. On reaching the Island the 10-in. pipe will connect with a 12-in. cast-iron line leading to the storage reservoir.

Several joint types considered

Two major requirements had to be met by expansion joints on the bridge: (1) the absorption of any movement of either pipe or bridge at points where there are expansion joints in the bridge structure and (2) absorption at intermediate points of movement arising from differential expansion and contraction between the bridge itself and the water pipe line.

The danger that leakage from a connection of the orinary packing joint type might result in interference with traffic led to a request from the California Toll Bridge Authority that, so far as possible, pipe connections should avoid moving parts made watertight by means of packing. An expected movement as large as 30 in. at the end of each span made it impracticable to use flexible loops because the large overall dimensions of loops between decks would seriously interfere with operation of painting and maintenance platforms.

Two types of expansion joints were employed. The simpler of the two, used for the differential expansion on the bridge runs, uses a modified arrangement of a commercial expansion joint of high grade in which the gland is drained so that discharge of any leakage can be controlled. This arrangement made it possible to convey leakage away from the bridge decks.

This type of joint could not be used at the ends of the long span because here the pipe would be subject to movement in both vertical and horizontal planes. Flexible metallic and rubber hoses arranged in multiple units were considered and rejected. The design finally adopted for the span ends is a transverse pipe connection (Fig. 1) arranged so that the 30-in. horizontal movement is converted into a small angular deflection (3½ deg.) in the alignment of the main and transverse pipes where provision is made for absorbing this movement in spherical joints.

Spherical joint design

No spherical joint was found on the market that satisfactorily met the requirements for rugged, leakproof construction. Accordingly, design of a special joint was undertaken. The design was simplified somewhat and the weight of the joints was materially reduced by making them of 8-in. diameter instead of 10-in. used for the remainder of the bridge pipe. Losses in capacity resultant from this smaller diameter were not comparable to the resultant saving in weight and cost.

Details of the joint are shown in Fig. 2, from which the assembly and operation of the joint will be apparent. The plan is to have each joint inspected at regular intervals. Alemite connections are provided to maintain a supply of lubricant insuring easy sliding of the sphere. To reduce the danger of wedging action where the angle of contact is small an additional groove was made in the middle portion of the spherical surface indicated by "*A*" in Fig. 2. Stainless steel bolts were specified to reduce size and weight and insure long life in exposure to salt fog.

The joint is made watertight by a rubber ring whose inner sides are reinforced with canvas and whose outer face is backed with a bronze band which prevents pinching the rubber. Internal pressure tends to close the joint between rubber ring and housing.

This rubber ring might develop leakage if the water found a path under the inner side, or if friction against metal corners wore through the rubber. Safeguards against these risks are provided by tapering the inner sides of the ring slightly so that the initial pressure comes on the steel halves of the joint, and by cementing the inner sides of the ring to the abutting pipes; also the edges of bronze ring and the steel housing are rounded off to minimize chafing. Specifications require the rubber in the ring to have a tensile strength of 3,600 lb. per sq. in. and a set not more than 25 per cent after an initial stretch of 500 per cent.

If leakage does occur through this joint it would be discharged through a $\frac{3}{4}$ in. pipe draining the hollow space immediately outside the rubber ring. Another safeguard against leakage around the spherical contact surface is provided by packing consisting of a U-shaped chrome leather ring with a rubber insert to supply initial pressure to the leather.

Tests for the first joint

Specifications required the contractor to manufacture one sperical joint and subject it to a series of tests to determine its ability to withstand deflection under pressure without leaks. Manufacture of the remaining 24 joints required for the bridge crossing was to proceed only if the design successfully passes this test. Terms of the contract leave details of construction to the manufacturer; the features shown in Fig. 2 are intended to represent a design in principle which the manufacturer

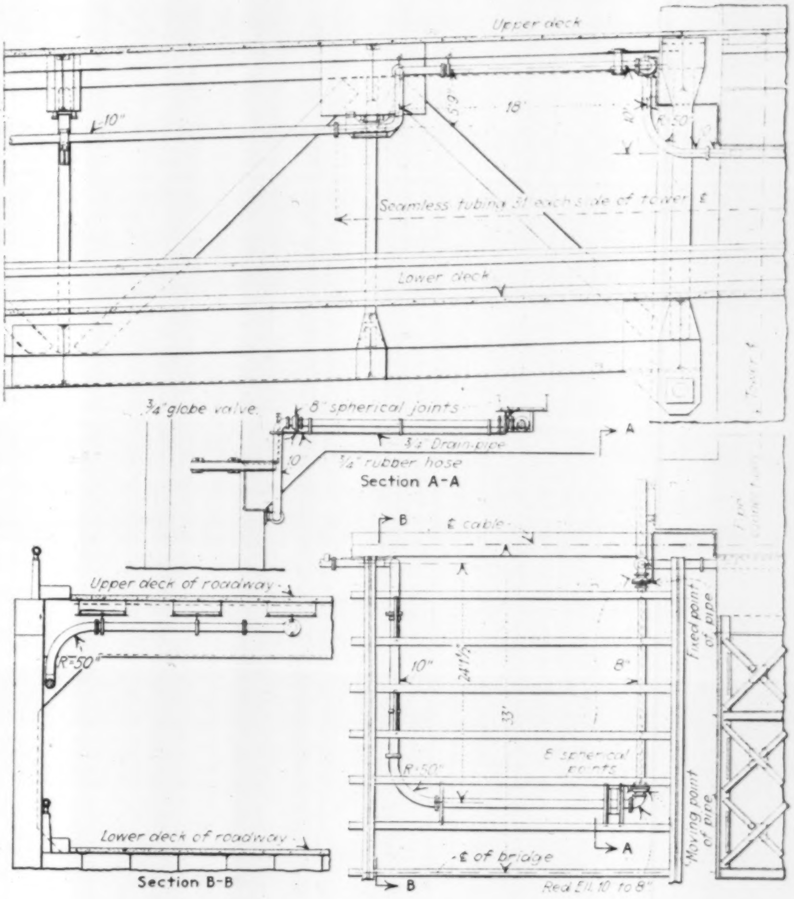

Upper deck
10"
5'9"
18'
R=50"
Seamless tubing 31' each side of tower ℄
Lower deck
Tower ℄
¾" globe valve
8" spherical joints
¾" Drain pipe
¼" rubber hose
10"
Section A-A
A
B
℄ cable
A
Upper deck of roadway
R=50"
10"
24'11½"
8"
33'
8" spherical joints
R=50"
Fixed point of pipe
Moving point of pipe
Lower deck of roadway
Section B-B
℄ of bridge
A
B
Real El. 10 to 8"

Fig. 1. Arrangement of pipes at points where movement is taken up by spherical joints, made watertight by the use of a rubber ring.

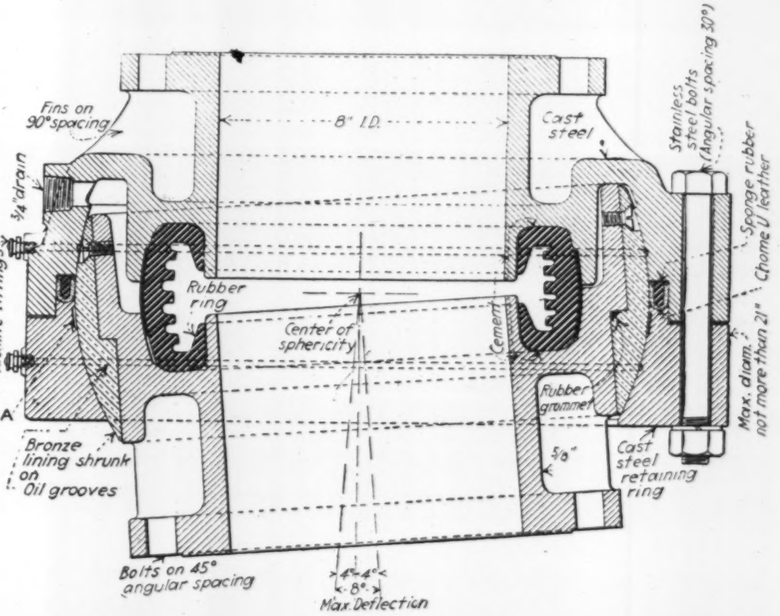

Fins on 90° spacing
8" I.D.
Cast steel
Stainless steel bolts (Angular spacing 30°)
¾" drain
Alemite Fittings
Sponge rubber
Chome U leather
Rubber ring
Center of sphericity
Cement
Rubber grommet
Max. diam. not more than 21"
A
Bronze lining shrunk on
Oil grooves
⅝"
Cast steel retaining ring
Bolts on 45° angular spacing
4° 4°
8°
Max. Deflection

Fig. 2. Longitudinal section through the spherical joint, showing rubber ring.

is expected to apply to the joint in a practical way.

Throughout the spans of the bridge the length of pipe between differential expansion joints varies from 240 to 420 ft. At each of these joints the pipe on one side is anchored to the stiffener truss and on the other side the pipe is free to slide. On reaching the last panel of each suspended span the pipe rises to clear the traveling maintenance platform and terminates in a spherical joint which constitutes the moving point of the transverse pipe.

Fixed point linkage

The other end of the articulated pipe section, as indicated in Fig. 1, connects through another spherical joint with a portion of the pipe securely anchored to tower or anchorage, thus constituting the fixed point of the linkage. When movements of the span occur the moving point in the pipe describes an arc around the fixed point and for this reason the supports for the pipe in the last panel of the span are arranged to permit a certain amount of motion in a direction transverse to the bridge center line. At the same time motion in a longitudinal direction is prevented so as to insure stability of the linkage under abrupt changes of water flow.

The ¾-in. drain pipes have a globe valve at each spherical joint and a rubber hose is used for flexibility. The drainage lines discharge through a funnel near the lower deck in order to give visual evidence of any leakage that occurs.

As two spherical joints are required at each end of the six bridge spans, the total number of joints needed will be 24. One additional joint has been ordered as a spare making a total of 25 in the contract.

The United Engineering Co., San Francisco, which has a contract for manufacturing the spherical joints, recently made the test on the initial joint as prescribed, under a test pressure of 260 lb. per sq. in. This load was applied in increments of 20 lb. and each advance in pressure was maintained for 30 minutes. As this test showed that the joint could articulate at these pressures without leakage, manufacture of the remaining 24 joints was approved in accord with the design illustrated.

Boulder Dam Contract Revision

Early completion of plant and burdensome terms of original power pacts are grounds for new terms

Special Correspondence

[*Because of the unusual nature of the movement to change the terms of the formal contracts for sale of Boulder Dam power, the following statement of the chief background conditions and reasons is instructive. It is based on authoritative information.*—EDITOR.]

COMPLETION of Boulder Dam and its power plant earlier than planned under the original schedule and the claim that certain features of the power contracts are unduly burdensome to the purchasers are leading motives in the current movement to bring about revision of the contracts. One important argument advanced is that the present contracts would put southern California under a competitive disadvantage as against other regions served by federal power, particularly the Northwest with the government's Bonneville plant, and that the latter would offer greater inducement to new industries in search of a location offering cheap power. Contract revision has been under discussion for the past year and is the subject of Congressional bills.

In seeking such legislation the Los Angeles Bureau of Power & Light and the Metropolitan Water District aim at the correction of such inequalities as interest rates, allocation of construction costs, period of amortization, and development-period charges. The power bureau requests that the President designate an agency to hold public hearings to determine whether there is unreasonable discrimination against Boulder power, while the water district seeks relief from costs and taxes not commensurate with the original intent of the act and burdensome during the initial period of operation of the Metropolitan Aqueduct.

The Boulder Dam Act original terms provided that before construction the Secretary of the Interior should make provision by contract for revenues adequate in his judgment to repay to the government the cost of the reservoir, dam and power plant with 4 per cent interest within a period of fifty years. These contracts, entered into in 1930, are the principal and practically the only sources of revenue. They fix the rate for falling water at 1.63 mills per kwh. for firm energy and ½ mill for secondary power. Assuming that only two-thirds of the firm power is sold, the assured revenues would completely amortize the costs of the project. Excess revenue is allocated 18¾ per cent to the state of Nevada, 18¾ per cent to Arizona and 62½ per cent to amortize the $25,000,000 allocated to flood control. Payments to Arizona and Nevada are in lieu of taxes which might have been collected were the project privately owned. After complete amortization the proceeds from the dam would go into a separate fund to be used as directed by Congress for further development of the Colorado River Basin. The so-called Upper Basin states of Colorado, Utah, Wyoming and New Mexico have frequently taken the position that this "separate fund" was to be used for their benefit.

Because the 1930 federal administration did not look with favor on government power generation, operation of the plant is in the hands of the Bureau of Power & Light for power to be used by itself, the water district, other southern California cities and other states; the Southern California Edison Co. will generate for itself and other private power companies.

The modifications sought would alter these provisoins in conformity with precedents set by the later policies established for Bonneville, TVA and Grand Coulee.

The Metropolitan Water District bases its appeal upon six contentions:

1. Although Boulder Dam was built in part to provide flood control,

no allowance was made for this factor in setting the 1930 power rates. It is now commonly conceded that power rates of federal projects should be based upon capital and operating costs attributable to power generation, excluding costs chargeable to flood control and navigation. To obviate unfair economic competition it urges that the $25,000,000 allocated to flood control be removed from the power rate base and that at least $5,000,000 additional be removed and allocated to navigation.

2. In the belief that one agency can operate the power plant with greater efficiency and more economy than two or three, the district recommends that the federal government assume centralized operation of the dam and power plant; estimated annual savings are $220,000 to $400,000.

3. The original contract obligates the district to begin to take and use power one year after the Secretary of the Interior announced that power was ready for delivery to Los Angeles (June 1, 1937). Because the dam was completed ahead of schedule and the district will not require power for pumping until 1939 or 1940, it requests that its obligation to take power be deferred until such time as it will begin operation of the aqueduct (probably 1940).

4. The present contracts require that the entire cost of power generating equipment be amortized within a period of ten years. Such a provision tends to make the cost of power unduly high during the initial critical load-building period. The district recommends that the time be extended to fifty years, the same period fixed for other features of the project, with a consequent saving in operating costs of $485,000 annually during the first ten years of the aqueduct's operation.

5. No particular load-building or absorption period is recognized in the act or the power contracts, which require that a purchaser take 55 per cent of its final allotment during the first year of use and 15 per cent additional per year for the next three years. The rate of power increase for pumping will not approach such a demand. Hence the district requests that the load-building period be extended to fifteen years, with payments arranged over the entire 50-yr. life of the contract so that the ultimate return to the federal government will be the same.

6. Because the 4 per cent interest rate is higher than the actual cost of money to the government today, it is urged that the interest rate be reduced to 3 per cent, with corresponding reduction in power rates. This will not affect the net income from the project.

The competitive argument

In the main the Los Angeles Bureau of Power & Light concurs with contentions 1, 4, 5 and 6. It objects to 2, holding that no change should be made in the plant operating arrangements. Major basis for its claims is the unstrategic competitive position in which it is placed by the discriminatory features of the Boulder Canyon Act and its subsequent power contract in soliciting new industrial enterprises in competition with the Columbia Basin region with its Bonneville and Grand Coulee projects. Low-cost power has long been a powerful sales agreement in attracting industries.

Officials of the power bureau disclaim any desire to bring about the establishment of uniform rates among all of the major federal power developments. E. F. Scattergood, chief electrical engineer and general manager of the bureau, states its case thus:

"Clearly the general public interest requires early and concurrent action providing for the definite determination and harmonizing by a common agency of power rates at the Bonneville and Boulder projects. Millions of industrial capital is held in abeyance pending such definite determination. With rates harmonized, certain industries would go to Bonneville, certain to Boulder, and other classes to both regions because of combined raw material, power and market conditions."

The campaign to modify the Boulder contracts and to "harmonize" power rates between it and competing federal projects is strengthened by the government's changed attitude toward federal power. Boulder, first of the large national power projects, was launched under an administration antagonistic toward government operation; it was made self-supporting from the start and was denied any allowance for flood control, navigation or relief. In sharp contrast, Bonneville, TVA and Grand Coulee include these allowances. In order that Boulder may compete with them, contract features initially regarded as sound economics will have to be modified.

• • •

Sanitation Department Service in New York Expanded by District Organization

THROUGH the aid given by the federal government under the provisions of the Social Security Act it has been possible for the New York State Department of Health to reorganize its Division of Sanitation to provide district engineering service in most sections of the state. As now organized there are 15 district sanitary engineers stationed at Buffalo, Rochester, Hornell, Ithaca, Syracuse, Binghamton, Utica, Oneonta, Gouverneur, Saranac Lake, Glens Falls, Albany, Amsterdam, Poughkeepsie and Middletown.

Each district engineer is attached to the staff of a district state health officer and carries on routine work relating to supervision over the operation of public water supplies and sewage treatment plants, camps, swimming pools, nuisances, investigation of various sanitary problems, representing the Division of Sanitation generally on most sanitary engineering matters arising within his district.

The central office of the division in Albany has been reorganized to include four bureaus (milk control, water supply, camp sanitation and sewage and waste disposal) with experts in each bureau specialized in certain fields of work such as filter plant operation, sewage plant operation, review of sewerage plans, review of plans for water supply, review of swimming pool plans, and major problems. The work of district engineers is coordinated under the several bureaus. The staff of the central office, the members of which are experienced in particular lines of work, is available to supplement the work of the district engineers in handling special studies.

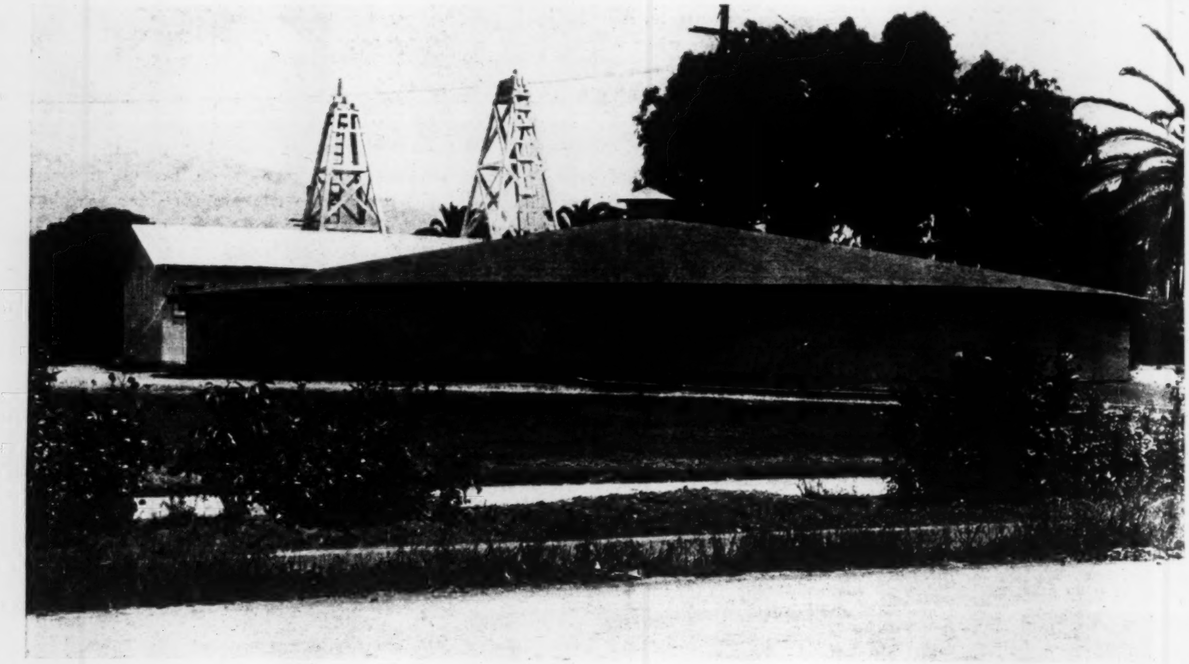


FIG. 1. COVERED RESERVOIR OF 0.2 M.G. CAPACITY AT LA VERNE, CALIF., WHERE THE EVAPORATION STUDY WAS MADE

Evaporation Loss in Covered Reservoirs

by A. A. Young

Associate Irrigation Engineer, U. S. Department of Agriculture, Pomona, Calif.

Study of evaporation characteristics of covered reservoirs with limited ventilation indicates that little water is conserved through use of roof structures

Investigation of evaporation losses from a covered reservoir having limited ventilation indicates that some conservation of water is effected by a cover but not in sufficient quantity to warrant a roof installation for this purpose alone. During an eleven-month test period at the 200,000-gal. covered reservoir in La Verne, Calif., the actual saving was found to be but 13.7 in. of water.

The study was undertaken to ascertain the evaporation rate and loss from covered reservoirs, regarding which there is comparatively little information, in order to determine the desirability of roofed structures. A large number of small reservoirs are in common use in Southern California for regulation of irrigation for domestic water supplies. Perhaps 75 per cent of the irrigation is accomplished by pumping from wells, which in many cases have lesser capacities than are necessary for economic irrigation, thus making some degree of storage necessary. There is a choice of either an open or a covered reservoir and both kinds are in common use. Municipal reservoirs, however, are generally roofed over to provide necessary protection to the purity of the supply.

The test reservoir

The reservoir selected for the investigation was small in comparison with those used in large communities but was eminently satisfactory for the study intended. It had a diameter of 60 ft., a depth of 10 ft., and capacity of about 200,000 gal. The water supply, coming from underground sources, has a consistently uniform temperature ranging from 74 deg. F. in the summer to 70 deg. F. during the winter.

The protective structure consists of a circular frame wall with a black tar-paper roof sloping up to a peak in the center. The wall is 5.5 ft. high with the upper 14 in. screened to permit ventilation. The tank is within a few feet of other buildings in a closely settled neighborhood but is completely exposed to sun and wind on the south and east sides.

Two standard Weather Bureau pans were used in obtaining evaporation data; a floating pan was used in the reservoir and a land pan outside. Depth of water in the floating pan was maintained so that the exposed rim approximated $1\frac{1}{2}$ in. both within the pan and without.

Evaporation data from the floating pan were obtained by cup measurements which raised the water surface to a fixed index point at each filling. The maximum variation in the water surface was 0.4 in. The cup was designed with a small neck for accuracy and had a capacity equivalent to one-tenth of an inch of water in the floating pan.

Evaporation measurements were made from the land pan by a hookgage. Fluctuations of the water surface did not exceed one inch except during storms. Standard practice was followed. Unless otherwise necessary measurements were made twice a week, exceptions being on the first of the month and in rainy weather.

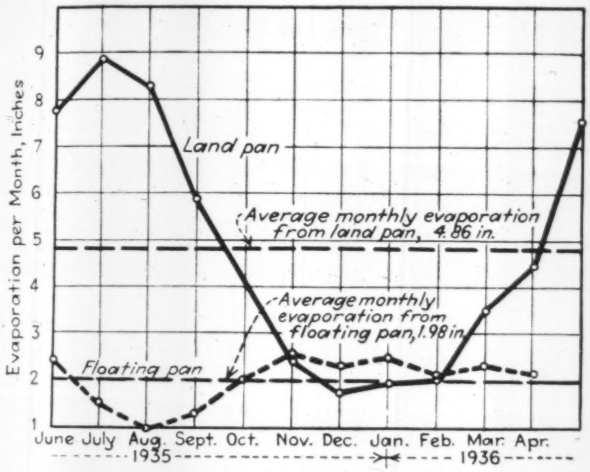


Fig. 2. Comparison of evaporation from a floating pan in the covered reservoir and an exposed land pan.

Factors affecting evaporation

Factors affecting evaporation within a covered reservoir are different than those at points outside the protecting roof. For instance, light is admitted only through the ventilating screen immediately below the wide eaves of the roof, resulting in a sharp reduction of the amount of radiant energy received at the water surface. Although a slow circulation of air occurs no wind enters the reservoir below the level of the ventilating screen. Due to the relatively high water temperature the air temperatures at the water surface during the winter months are higher than at outside points.

Limited ventilation within the reservoir and the protection afforded by the roof cause an unequal distribution of temperature, the lowest being at the water surface and the highest under the roof. A test in mid-summer showed the following temperatures at different heights above the floating pan:

At water surface	84 deg. F.
2 ft. above surface	86 " "
8 ft. above surface (roof)	95 " "

The outside air at this time was 84 deg. and the temperature of the water 72 deg.

Internal air temperatures at the water surface are more uniform than external temperatures due to the influence of the warm water coming into the reservoir. Daily variations seldom exceed 20 deg. regardless of season, and average much less.

Water temperatures likewise are uniform, varying little from day to day. A continuous record during November showed a maximum difference of but two degrees. Although continuous water temperatures are not available, those obtained during the morning observations showed seasonal changes ranging from a maximum of 74 deg. in July to a minimum of 63 deg. in December.

Dalton's Law applied

All evaporation formulas, in whatever form, are based upon the fundamental law developed by Dalton which, in brief, states that if all other factors are constant the rate of evaporation is proportional to the difference of the vapor pressure of the saturated vapor at the temperature of the water surface and the vapor pressure of the saturated air at the temperature of the dew point. The Dalton law has been tested under a variety of conditions which have proven its general usefulness.

Under certain conditions, however, it may indicate zero or even negative evaporation. When the humidity is 100 per cent there can be no evaporation due to saturation. Although there is little wind movement in the reservoir to carry off moisture-laden air, humidity charts show but short periods of saturation so that zero evaporation from this cause is relatively unimportant. There is, however, a vapor blanket of relatively high humidity immediately adjacent to the water surface which retards evaporation at all seasons of the year regardless of the water-air temperature relation and is one of the principal causes of the consistently low reservoir rate of evaporation.

When the water is colder than the air there may be a negative difference in the vapor pressures and the computed evaporation becomes negative as may be demonstrated by substituting values of vapor pressures in a formula developed by Carl Rohwer. (Evaporation from Free Water Surfaces. *Tech. Bull.* No. 271, U. S. Dept. of Agric.) At such times some of the moisture in the immediately adjacent atmosphere may return to the colder water surface although the actual contribution might be negligible. This temperature relation prevails at the La Verne reservoir during much of the summer and is one of the causes of the very low rate of evaporation during the warmer months. The minimum monthly loss, occurring in August, was but 0.90 in. in contrast with 8.27 in. from the land pan outside the reservoir.

When the water is warmer than the air, at less than saturation point, the difference in vapor pressures is favorable for evaporation, which accounts for the increased loss during the cooler months. Such a temperature relation is possible only because of the relatively warm water constantly entering the reservoir. As the water-air temperature difference increases, evaporation also increases, reaching a maximum of 2.50 in. per month in November and again in January. The difference between summer and winter evaporation, both in the reservoir and outside, is best illustrated by Fig. 2 which shows monthly rates of evaporation from both floating and land pans.

Evaporation is further affected by the moisture content in the air. The absence of wind over the water surface and the shelter of the protecting roof goes far to preserve in immediate contact with the water surface a higher relative humidity than exists outside the reservoir.

Some conservation of water is effected by a reservoir cover although not in sufficient quantity, if its value be capitalized, to pay for the cost of roofing. The principle benefit lies in preserving the purity of the water.

The difference in the amount of evaporation between the floating pan and the land pan was 28.96 in. for the period June 1, 1935 to April 3, 1936. As the mean temperature of the water in the floating pan was so nearly the same as in the reservoir (about one degree less) it is safe to assume that its evaporation loss was closely approximate, if not equal to, the actual reservoir loss.

On the other hand, if the general accepted coefficient of 0.70 be applied to evaporation from the land pan to reduce it to reservoir value, the saving becomes 13.7 in., very little compared with the roof cost.

Drilled Piles Seated in Rock Sockets

Load capacity of special concrete-filled pipe piles for New York City municipal garage increased by extending steel H-core and concrete several feet into bedrock.

Foundation work, recently completed on a department of sanitation garage building at 56th St. and 12th Ave., New York City, involves the use of large-capacity concrete-filled steel pipe piles or caissons of unusual and interesting design. The unique characteristic of these "foundation columns," as they are called, is that a considerable proportion of the load is delivered to bedrock not by direct bearing on the surface of the rock but by bond in the rock. This is accomplished by extending the construction into a rock socket drilled below the bottom of the steel pipe. This article describes these drilled caissons and a test which preceded their adoption for this garage job. Although similar drilled caissons have been used before, notably under the Times-Star Building in Cincinnati (*ENR*. May 11, 1933, p. 586), the basis of their design and the details of their construction have not been presented previously. Also, the test for the New York job affords the first check on the amount of rock bond that is available to carry loads.

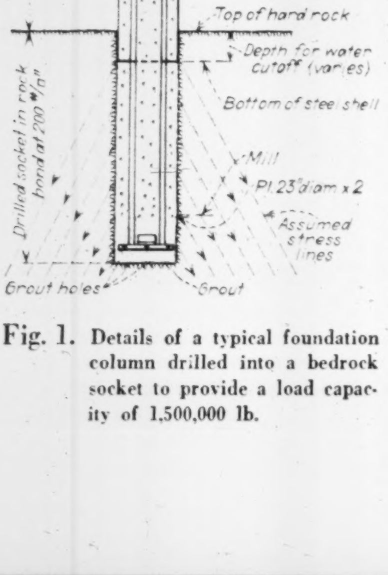


Fig. 1. Details of a typical foundation column drilled into a bedrock socket to provide a load capacity of 1,500,000 lb.

As shown in Fig. 1, the foundation columns used under the garage building consist of an extension of the building columns of the superstructure, placed in 24-in. concrete-filled casings through which they pass into uncased sockets drilled into the bedrock. Essentially, the construction consists of three parts: (a) a column cap, designed to transfer load from the superstructure column to the foundation column; (b) a column consisting of a steel H-core encased in concrete within a steel pipe and designed as a composite column, which transmits the load from the base plate of the superstructure columns to the bearing section; and (c) a rock socket by means of which the load is transferred from the column to the rock, that is, part of the load on the H-section is delivered by bond to the surrounding concrete, and this concrete in turn delivers load, also by bond, to the rock socket walls. With this type of foundation, part of the load is carried in direct bearing and part in bond. By assuming a unit bond stress

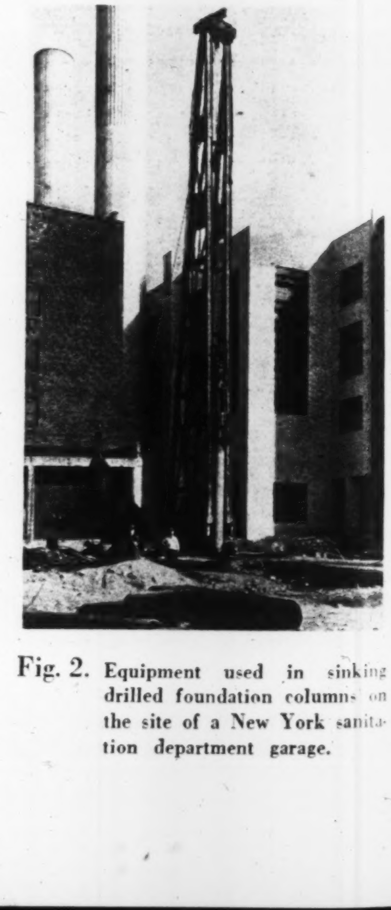
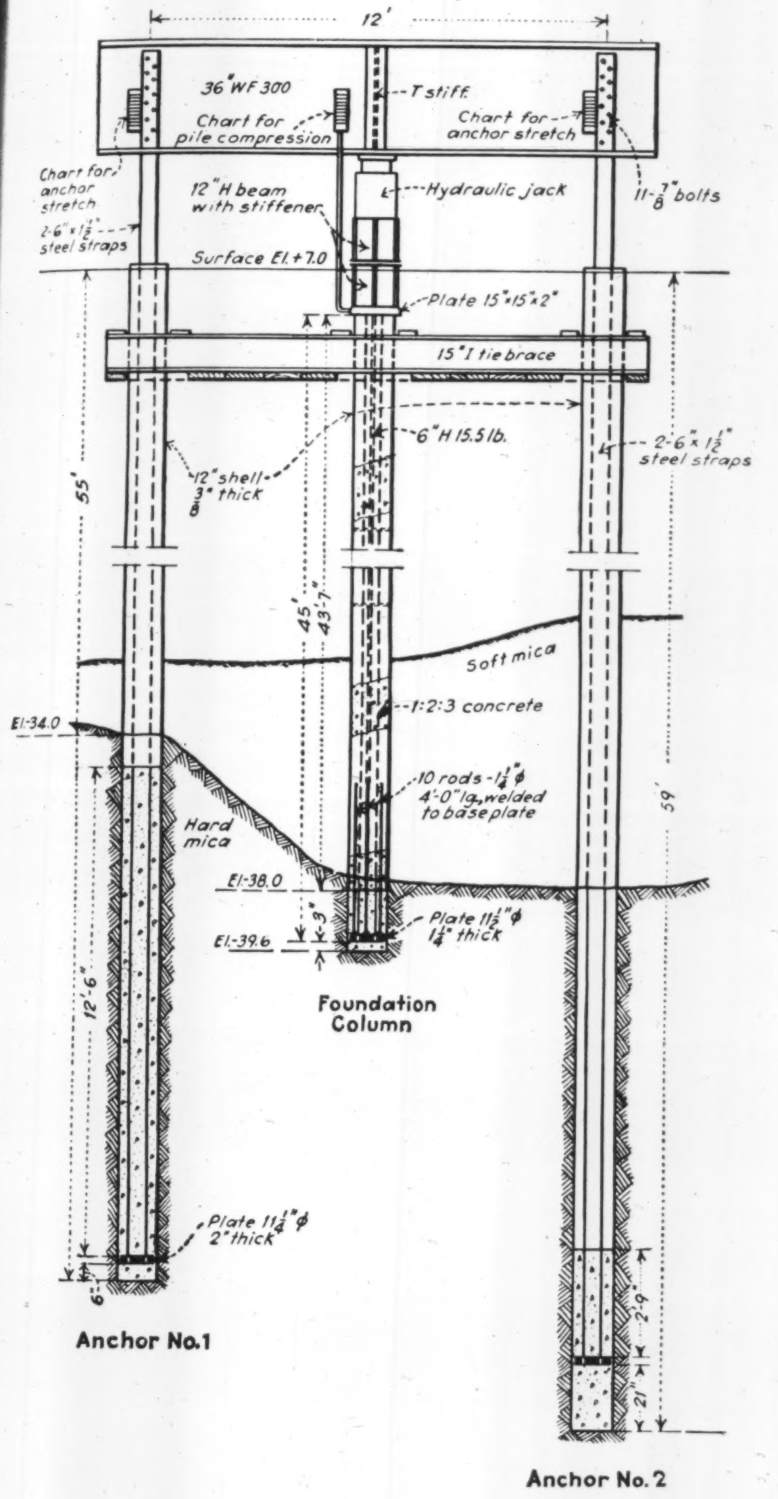
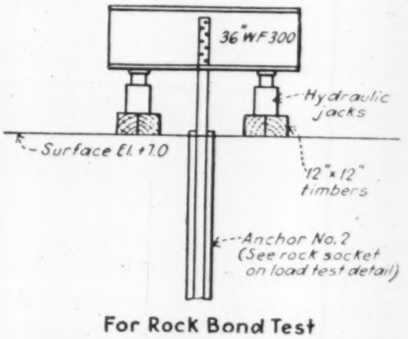


Fig. 2. Equipment used in sinking drilled foundation columns on the site of a New York sanitation department garage.


12'
36" WF 300
T stiff.
Chart for pile compression
Chart for anchor stretch
Chart for anchor stretch
12" H beam with stiffener
Hydraulic jack
11-7/8" bolts
2-6" x 1 1/2" steel straps
Surface El. +7.0
Plate 15" x 15" x 2"
15" I tie brace
6" H 15.5 lb.
2-6" x 1 1/2" steel straps
12" shell 3/8" thick
55'
45'
43'-7"
Soft mica
1:2:3 concrete
El. -34.0
10 rods - 1 1/4" ɸ 4'-0" lg., welded to base plate
59'
Hard mica
El. -38.0
3"
El. -39.6
Plate 11 1/2" ɸ 1 1/4" thick
12'-6"
Foundation Column
Plate 11 1/4" ɸ 2" thick
6"
Anchor No. 1
2'-9"
21"
Anchor No. 2

For Load Test


36" WF 300
Hydraulic jacks
Surface El. +7.0
12" x 12" timbers
Anchor No. 2 (See rock socket on load test detail)

For Rock Bond Test

Fig. 3. Test set-ups for determining load capacity of a foundation column and the value of the bond developed in the rock socket.

of 0.05 f'_c, or less between the concrete and the rock, the depth of the rock socket, necessary to carry the load not accounted for by direct bearing, can be determined.

It is claimed for this type of foundation that it can be used to any depth and placed through any type of soil. Since it occupies no more space than the building column, its use eliminates cantilevers and makes it possible to place foundations in restricted spaces and with great accuracy as respects spacing and plumbness. Further, its capacity may be definitely established, it is claimed, because the drilling of the socket tests the rock; also the large size of pipe casing used permits visual examination of the rock.

In constructing the foundation columns, the steel pipe casing, shod with a heavy alloy-steel cutting shoe, and a pipe core, equipped with removable cutting tools, are driven simultaneously. From time to time the core is withdrawn, the cutting tools removed and the soil in the core ejected. When the pipe reaches the surface of the rock, the method of procedure is changed, and regular cable-operated drilling tools are introduced. Using a reaming bit, an oversize hole is drilled into the rock, and the cutting shoe of the pipe driven into this reamed hole (through any disintegrated rock and into hard rock) to seal off and exclude sand and surface water. The drilling then continues until the rock socket is formed in the solid rock to the necessary depth. After examination of the rock, grout is introduced to level up the bottom of the hole and incase the bearing end of the H-core which is lowered into place. The casing is then filled to the top with concrete.

Because this type of foundation differed so radically from previous pile or caisson foundations in New York City, the municipal building department required that it be subjected to tests on the garage site as a preliminary to its approval. Below the 40 to 50 ft. of rubbish fill and river silt on the site, bedrock consisted of a comparatively soft, faulted and fractured mica schist, and the building department was unwilling to allow a load in excess of

60 tons per sq. ft. as direct bearing on this material. For a 24-in. column, therefore, the permissible load in direct bearing was about 400,000 lb., and since some caisson columns had to carry as much as 1,500,000 lb., it was required to know if the rock socket would contribute the necessary extra capacity. The purpose of the test that was devised was twofold: (1) to test the bond between the rock and concrete; and (2) to determine the total capacity (direct bearing plus bond in the rock) of the test column.

Design of test pile

The test set-up used is illustrated in Fig. 3. The test column, a reduced scale model of a typical full-size foundation column for the garage building, is in the center, and on either side are anchor piles attached to the jacking beam through which the test column was loaded. In designing the test column, steel in the pipe casing was figured at 7,500 lb. per sq. in., the H-core at 18,000 lb. per sq. in., the concrete at 600 lb. per sq. in., the bond between rock and concrete at 200 lb. per sq. in., and the bond between steel and concrete at 160 lb. per sq. in.; the direct bearing value of the rock was assumed at 60 tons per sq. ft.

Using these unit stresses the working load on the foundation column was fixed at 257,070 lb. or $128\frac{1}{2}$ tons, made up as follows:

Pipe, 14.58 sq. in. × 7,500 = 109,350

H-Core, 4.59 sq. in. × 18,000 = 82,620

Concrete, 108.5 sq. in. × 600 = 65,100

Total, 257,070

Inasmuch as the bottom bearing area of the $12\frac{3}{4}$-in. diameter pipe multiplied by the allowable 60-ton per sq. ft. pressure is 106,370 lb., this figure subtracted from the working load of 257,070 lb. left 150,700 lb. to be carried by bond in the rock. Multiplying the circumference of the $12\frac{3}{4}$ in. diameter rock socket, 40 in., by the unit bond stress of 200 lb. per sq. in. gives 8,000 lb. per vertical inch of socket. Dividing 150,700 by 8,000 gives 19 in. as the necessary depth of the rock socket. All dimensions and quantities were carefully checked.

The first part of the test consisted in loading the foundation column through a hydraulic jack reacting against a 36-in. 300-lb. beam attached to the anchors. A total load of 321 tons ($2\frac{1}{2}$ times the working load) was carried, with a final net settlement, after release and recovery, of 1/16 in. The temporary elastic deflection under full load was $\frac{1}{2}$ in. A later test made to 414 tons produced no increase in the permanent set.

In considering the question of bond in the rock socket, it was evident that a compression bond (such as exists in service) would give a higher value than could be developed by a tension bond, but no practical means could be devised for segregating the compression bond from the direct bearing value. Accordingly it was decided to test the tension bond of one of the anchors. The test set-up, shown dotted in Fig. 3, consisted of hydraulic jacks, inserted between the jacking girder and timbers on the ground, which exerted a pull on the anchor. As shown in Fig. 3, the anchor consisted of two $6\text{x}1\frac{1}{2}$-in. steel straps inside of a 12-in. pipe and extending below the bottom of the pipe into a rock socket. A steel plate welded to the bottom of the straps was embedded 2 ft. 9 in. in concrete at the bottom of the rock socket. To assure a purely tension bond, the test was made in a tapered socket $\frac{1}{4}$ in. larger in diameter at the top than at the bottom. The socket was drilled with a well-worn bit to assure that the side walls would be smooth and unchipped. The side area of the drilled socket was 1175.79 sq. in.

This anchor was subjected to a direct uplift of 480,000 lb., giving a unit bond of about 385 lb. per sq. in., some $2\frac{1}{2}$ times the figure used in the design. Although two 200-ton jacks were used, the pull could not be increased because of the progressive settlement of the timber blocking laid on the ground surface. After the release of the load, recovery was complete, indicating that no slip in the socket had occurred.

On the basis of these tests, the drilled foundation columns were approved for use on the municipal garage but with somewhat more conservative working values than were used in the test. For example, concrete with an ultimate strength of 4,000 lb. per sq. in. is required. The 24-in. concrete-filled caissons, without the steel core, are given a base value of 250 tons, to which the structural core capacity may be added, up to a maximum of 75 sq. in. at 13,000 lb. per sq. in. The maximum permissible load, therefore, on a 24-in. diameter caisson, with the largest steel core is 1,475,000 lb. The depth of drilling in the hard rock below the pipe cutting edge is to be determined by the formula

$$D = \frac{\text{area of steel core (sq. in.)} \times 13{,}000\ \text{lb.}}{130{,}000}$$

On this basis a concrete-to-rock bond of about 150 lb. per sq. in. is allowed.

Personnel

The tests were made by the Western Concrete Pile Corp., a subsidiary of the Western Foundation Co. which holds patents on this type of foundation column. For the department of sanitation, Walter D. Binger is deputy commissioner in charge of the division of engineering. Joseph C. Zengerle is chief engineer of incinerators and garages and F. B. McDuffee is engineer of design and construction. At the request of the building department the tests were supervised by a committee of consulting engineers composed of G. L. Freeman of Moran, Proctor & Freeman; N. A. Richards of Purdy & Henderson; and John W. Pickworth of Weiskopf & Pickworth.

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Rack-Rail Line Electrified

ELECTRIFICATION of the Mount Pilatus Railway in Switzerland, a rack-rail line having grades of 20 to 48 per cent, is approaching completion. This line, rising 5,350 ft. in its length of three miles, was opened in 1889, and has been operated by steam cars, the engine driving adhesion wheels and also horizontal cog wheels for the rack, which is a flat bar having teeth on both sides. For the trolley line, each car will have two pantagraphs and will be mounted on a single axle at each end. Two 100-h.p. motors will drive a pair of cog wheels at the lower end of the car, while under the upper end will be a similar pair of wheels used only for braking purposes. The light weight is about 10 tons, and there is seating capacity for 40 passengers in the transverse compartments. The normal speed will be 5 m.p.h., maximum $7\frac{1}{2}$ m.p.h.

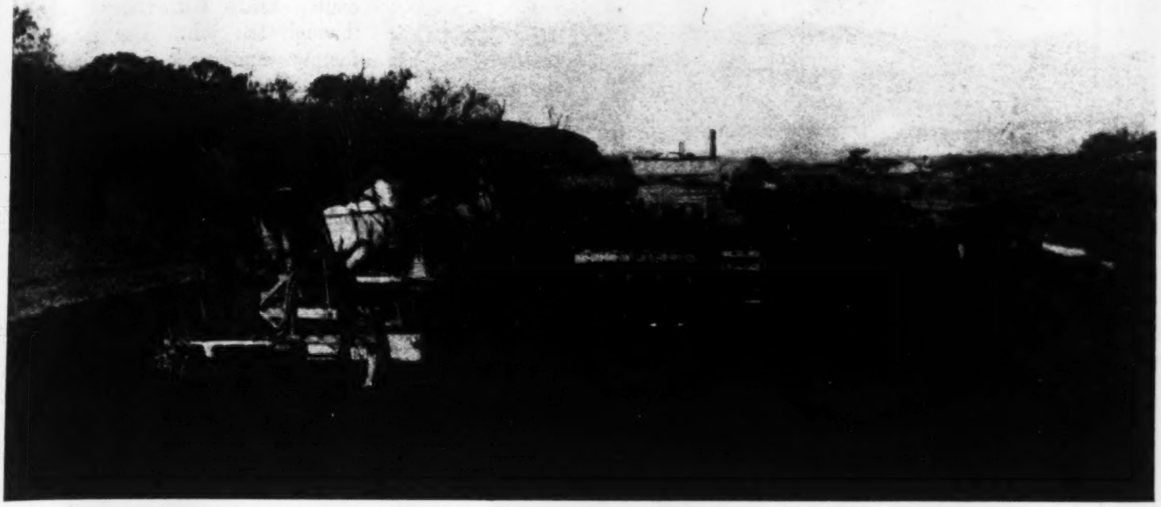


FIG. 1. CEMENT-AND-WATER IMPREGNATED SOIL COMPACTED BY SHEEPSFOOT ROLLER AND FINISHED BY BLADE GRADER

Road Soil Base Bound With Cement

by Harold Allen

Former Engineer of Materials, Kansas State Highway Department, Topeka, Kansas

Field methods and equipment used in stabilizing silty soil with cement are described, with practical observations on improvements needed

The testimony of roadbuilders who have had experience in stabilized soil base is that new and better equipment is needed. Until recently soil base stabilization has been experimental; the contractor has made use of the equipment at hand and the market has not been large enough to encourage manufacturers to design and produce special equipment. Of course there are exceptions, but in general especially-adapted equipment is lacking. As soil base stabilization becomes common, which it is rapidly doing, the market will enlarge and the equipment makers can be expected to become more active in invention and adaptation. —Editor

A cement-stabilized soil base 1 ft. thick was constructed in Kansas in 1936 under a concrete pavement. The soil consisted of a silty *A4* grade and was very unstable when wet. Representative samples were taken from the subgrade and soil compaction curves were drawn from the data obtained. It was determined that between 6 and 6½ per cent of cement would be satisfactory to produce the desired results. The maximum density of the raw soil as shown by the compaction curve occurred at a lower moisture content than that of the soil-cement mixture. An average soil-cement compaction curve was therefore obtained by averaging all of the data, and the field work was regulated by this average curve. The construction procedure on this work was as follows:

Double operation required

The roadbed was excavated to 6 in. above the bottom of the base course by an elevating grader and the dirt deposited on the shoulders. A rooter was then used to scarify the remaining 6 in. which was to be the bottom lift of the treated base. After the bottom 6 in. was scarified it was pulverized and dried by continuous disking and an occasional rolling; the rolling broke up the larger clods which accumulated near the edges of the pit.

After the bottom lift was pulverized an average unit weight per cubic foot of loose soil was obtained and the moisture determined. The average thickness of loose soil was obtained by taking measurements at various places on the bottom lift. The volume of loose soil was then determined. Knowing the weight per cubic foot of loose soil (dry) and the final compaction density anticipated, the approximate desired thickness of loose soil was calculated. After the moisture in the soil was determined the water necessary to bring the moisture content to 19 per cent was calculated and added to the water necessary to bring the dry cement to 19 per cent moisture.

The rate of cement application was 5 lb. per sq.yd. per in. of compacted depth. It was estimated that 8 in. of loose soil would make the

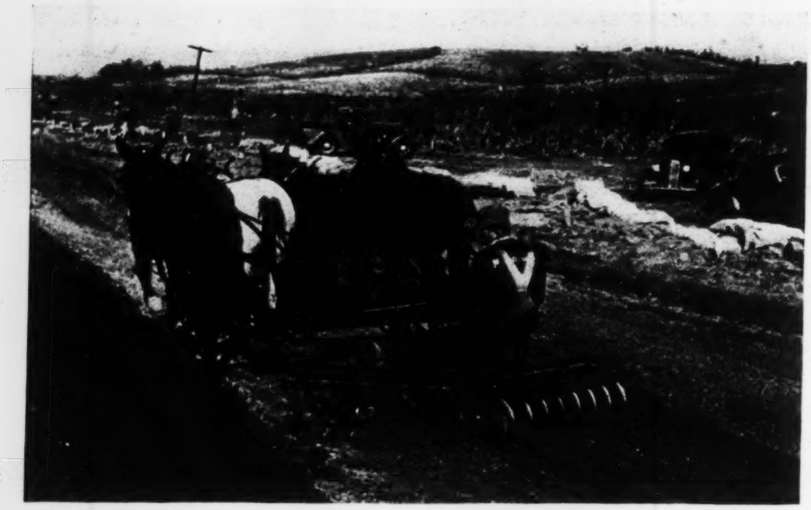


Fig. 2. Soil was finely pulverized before applying the cement; a horse-drawn disk harrow was one of the machines used.

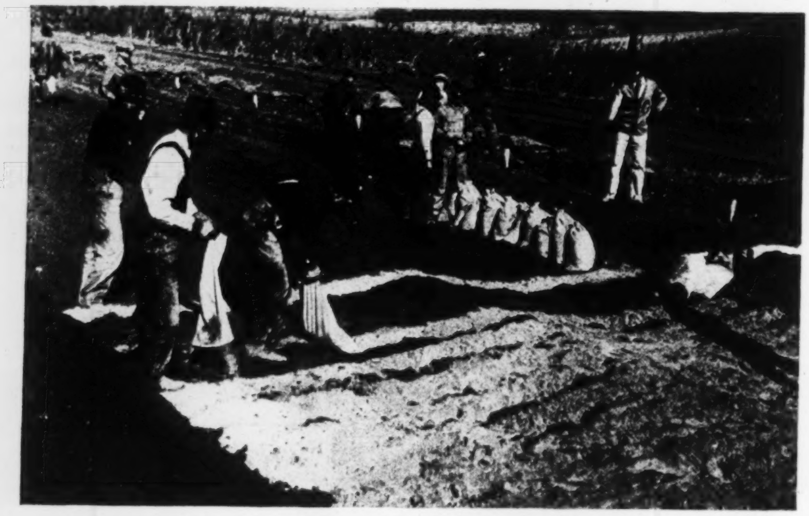


Fig. 3. Cement was spread by hand by the simple process of dragging opened bags mouth-down across the roadway.

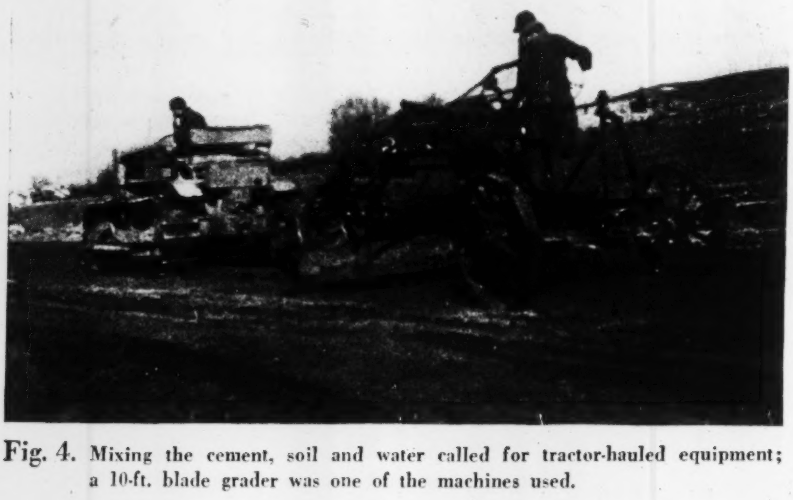


Fig. 4. Mixing the cement, soil and water called for tractor-hauled equipment; a 10-ft. blade grader was one of the machines used.

6-in. compacted lift, and this estimate held reasonably accurate through the job. The most satisfactory equipment for mixing was the tandem disk harrow and spring-tooth alfalfa-sod harrow in train; a gang plow; a walking plow to clean along the edges of the lift and a heavy blade. (The 10-ft. blade used was satisfactory.) Difficulty was met in mixing the cement with the lower part of each lift, and the 10-ft. blade was necessary to aid in this operation.

After the soil-cement mixture appeared homogeneous the water was added by $\frac{3}{4}$-in. hose with spray nozzles, connected to a 2-in. header pipe. The water passing through each hose was measured by a water meter. The water was distributed as evenly as possible and mixing continued during the process. Inspection by eyes and hands determined when sufficient water had been applied. Information as to the plastic state of the soil-cement mixture, when the required per cent of moisture was present, was acquired during the process of running the several compaction curves.

After the lift was uniformly mixed and shaped it was rolled with a single-drum sheepsfoot roller having a unit bearing pressure of 110 lb. per sq. in. This unusually high bearing pressure was obtained by loading the drum with sand instead of water or oil. Rolling was continued until the roller made no noticeable penetration in the soil-cement mixture.

The dirt for the top lift was bladed from the shoulder, where it had been pulverized, into the roadbed where it was to be mixed with cement. Two-up fresnoes aided in the process of bringing the top lift into place, and were especially useful in shaping the ends of each section and distributing the lift uniformly over the section. The process of determining the depth of loose soil to be placed, the water to be added and the amount of mixing necessary for the bottom lift was repeated for the top lift. During the time the sheepsfoot roller was rolling the top lift, high and uneven places were eliminated. A 7-ft. blade, two-up, was very useful in shaping the surface of the top lift during the rolling by the sheepsfoot roller and prior to rolling with the flat-faced three-wheel roller. The flat-faced roller was used to roll the loose material that was left on the surface after the sheepsfoot roller had finished, and was used on the top lift only.

Burlap was used during initial curing, and was kept wet when the weather required. The burlap was later removed and curing continued by covering the treated base with cushion soil from a borrowpit.

As an experiment two sections, each 250 ft. long, were prepared instead of a 500 ft. section. Each 250-ft. section was completed before the other was begun. It was believed that this would shorten the water application and mixing time and save evaporation losses due to wind and sun. However, congestion of machinery resulted due to the short section and the narrow 22-ft. trench in which the work was done. All pulverizing and mixing equipment had a tendency to carry soil on a straightaway and lose it on a turn, so that piling up the soil at each turn was an added difficulty and the construction of 250-ft sections was discontinued.

Improved water formula

The calculated water needed and the actual water used did not check reasonably close at first. Due to evaporation losses, while mixing the soil-cement and during the application of water, it was not expected that the calculated water needed would be as large as the actual water used, but such a wide variation as obtained on the first 500-ft. section was very unsatisfactory. The following procedure for determining the water needed was thereafter used with much better results. After the soil and cement mixing had been completed and prior to the application of water, an average weight per cubic foot of the soil-cement mixture was obtained, a representative moisture sample taken and an average depth of loose soil-cement obtained, then:

$$\frac{W}{100+M}\times 100=K$$

When

W = wt. per cubic foot of loose soil-cement as originally mixed

M = per cent moisture in original soil-cement mixture

K = wt. per cu. ft. of dry loose soil-cement as originally mixed

Letting D equal difference in the per cent of moisture of the soil-cement as originally mixed and the per cent of moisture wanted when final mixing was completed (the latter moisture content taken from the soil-cement compaction curves), then:

$$\frac{VKD}{8.345\times 100}=G$$

Where

V=volume in cu. ft. of loose soil-cement as originally mixed

G=Gallons of water to be added to the lift to produce moisture content at which maximum compaction may be obtained.

Fig. 5. After compaction the cement-treated soil was covered with burlap kept wet for curing.

This method eliminated an error in the former method used due to the evaporation of moisture while mixing soil and cement was in progress. It also permitted a more thorough mixing of the lift before the moisture sample was taken.

Ideal equipment for mixing the soil and cement (as well as the soil, cement and water) would be an implement or train of implements that would stir the entire lift of loose soil, varying from 8 to 9 in. thick, in such a manner that the bottom part of the lift would be brought to the surface repeatedly or during every stage of mixing. During construction of the treated base, much time was lost in moving part of a lift to one side while the bottom portion was mixed.

Due to the fact that tractor-drawn equipment packed the soil-cement mixture during the water application, it was thought advisable to use only horse-drawn equipment while the water was being added to the soil-cement mixture, but this was unsatisfactory.

In constructing the bottom lift in the depresed roadbed, having a width of 22 ft., the narrowness of the working area eliminated long trains of pulverizing and mixing equipment, due to the difficulty in turning.

The single-drum sheepsfoot roller was not entirely satisfactory because it was difficult to roll the edges of the treated base, as the extreme edges of the roller were 18 in. inside the extreme edges of the tractor pulling the roller. Rolling the edges of the base course could only be accomplished by placing one track of the crawler tractor on the shoulder outside of the depressed 22-ft. width of the treated base.

Difficulty was encountered in placing the cement on the lift and thoroughly mixing the cement with the loose, dry soil during periods of relatively strong winds. Winds having a velocity greater than 15 m.p.h. cause loss due to blowing.

Night construction of the treated base proved to be unsatisfactory due to the difficulty and deception of sight. It was difficult to distinguish soil and cement while they were being mixed. It was also difficult to determine, other than by touch, how uniformly the water was mixed.

Results obtained

The average maximum density of the raw soil was 1.69, and the average maximum density of the soil-cement mixture was 1.65. The average moisture content at which maximum density occurred for the raw soil was 17 per cent and that for the soil cement mixture was 19 per cent. The lowering of the average maximum density of the soil-cement mixture would indicate that the addition of the cement increased the void ratio of the soil.

The average per cent moisture of the samples taken from the completed base was 18.6 per cent and the average density of the samples taken from the completed base was 1.634. The field work followed the compaction curves in regard to moisture variation very closely; 100 per cent of standard compaction was not obtained, but warmer weather and daylight working conditions would probably have eliminated the deficiency.

The treated base as rolled in place is noticeably harder than the raw soil containing the same amount of moisture. The addition of the cement to the soil tends to make the mixture more brittle than compacted soil alone. It took from two and one half to three times as many blows with a sledge to penetrate the treated base with paving form pins as it did the untreated subbase.

Base Plate Design For Beams Takes Account of Deflection

by J. E. Lothers
Associate Professor of Architecture, Oklahoma A. & M. College, Stillwater, Okla.

Assumption of non-uniform pressure makes design method accord with actual conditions

In proportioning a base plate to distribute the load from the end of a beam to its masonry support, it is customary to consider the load as being uniformly distributed over the masonry. Thus, in the case of a simple beam with an end reaction, R, the area, bd, of the base plate is found by the equation, $bd = R/f_c$ in which b is the breadth of the base plate measured perpendicular to the beam; d, the depth to which beam and base plate extend into the support; and f_c, the allowable unit compression in the masonry.

Since a loaded beam always deflects and, therefore, places more stress on the inner edge of the support than on the outer, it is evident that the above equation gives values that are in error on the side of weakness. In the case of an undersized base plate, the inner edge of the masonry support tends to crumble until equilibrium has been established and, although the actual safety of the building is not threatened, unsightly cracks appear.

In practice, d is usually fixed by the depth of the support. It only remains then to find an equation for b such as will keep the stress, f_c, at the inner edge of the masonry within the specified amount. The following analysis is submitted with that end in view.

Starting with the elastic curve equation (second derivative of y with respect to x equals M divided by EI), any good text on strength of materials will show the necessary steps in arriving at the equation for the slope of the beam at its end in terms of the angle, θ, which the beam makes with the horizontal. For a uniformly loaded, simple beam, the equation is:

$$dy/dx = \tan\theta = \pm WL^2/24EI \qquad (1)$$

in which W is the total load and L, the span in inches. The plus sign applies to the right end of the beam and the minus sign to the left end. Since we are only concerned here with the numerical value of $\tan\theta$, the minus sign will be dropped.

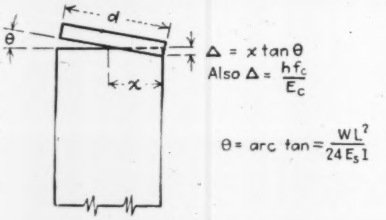


Fig. 1. Geometry of distortion of the edge of a masonry support under a steel base plate.

Let Δ equal the total distortion at the inner edge of the masonry support due to the weight of the beam, and let x equal the depth of contact between the base plate and masonry, as in Fig. 1. Then,

$$\Delta = x\tan\theta = xWL^2/24E_sI \qquad (2)$$

From the definition of Young's modulus of elasticity, $\Delta = hf_c/E_c$ in which h is the height of the masonry support; and E_c, its modulus of elasticity. Substituting this value for Δ in Eq. (2) and solving:

$$x = \frac{24f_chE_sI}{WE_cL^2} = \frac{24f_chnI}{WL^2} \qquad (3)$$

Assuming that the support is concrete, the allowable f_c for $n = 10$ is 750 lb. per sq. in.; for $n = 12$, 625; and for $n = 15$,500 lb. But since $nf_c = 10 \times 750 = 12 \times 625 = 15 \times 500 = 7{,}500$, the value of x is independent of the strength of the concrete in the support. In Eq. (3), x, h, and L are in inches. In order to keep x in inches and express h and L in feet, substitute $12h$ for h and $144L^2$ for L^2 in Eq. 3. Then, substituting $nf_c = 7{,}500$, Eq. (3) reduces to

$$x = \frac{15{,}000hI}{WL^2} \qquad (4)$$

in which x is in inches and h and L are in feet. Eq. (4) applies to any uniformly-loaded, simply-supported, steel beam resting on a concrete support, regardless of the strength of the concrete.

The problem resolves itself into two cases, that in which x equals or is less than d (Case I.) and that in which x is greater than d (Case II).

Case I—The upper part of Fig. 2 indicates that the load R brought in by the beam induces a triangular prism of stress in the concrete support. This stress prism has an altitude b and a triangular cross section one leg of which is the depth of contact, x, and the other, the stress, f_c in the masonry support at its inner edge. Since the volume of the stress prism represents R, then $\frac{1}{2}bxf_c = R$, whence

$$b = \frac{2R}{xf_c} \qquad (5)$$

This equation gives the required width of the base plate when the maximum allowable stress in the masonry support is substituted for f_c and the value of x is substituted from Eq. (4).

The value of x from Eq. (4) might be substituted in Eq. (5) resulting in a formula from which b could be obtained directly. However, there is no way of knowing to which of the two cases any given problem belongs until Eq. (4) has been solved for x. Therefore, it is better to leave Eq. (5) in the form given above and to substitute the numerical value of x as found from Eq. (4).

Case II—Where the conditions are such as to cause comparatively little deflection in the beam, the base plate maintains contact with the support for its full depth, and x is greater than d. Compression under the entire base plate results, the smaller value at the outer edge being represented by f_o. The lower part of Fig. 2 indicates that R is represented by a trapezoidal stress prism in this case, that is, $R = \frac{1}{2}(f_c + f_o)\,bd$, whence—

$$b = \frac{2R}{(f_c + f_o)\,d} \qquad (6)$$

By similar triangles (referring to the lower part of Fig. 2),

$$f_o = \frac{f_c\,(x-d)}{x} \qquad (7)$$

The value of x is obtained from Eq. (4) as in Case I.

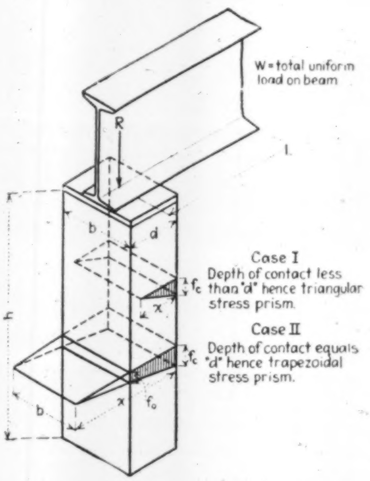

W = total uniform load on beam
R
L
b
d
Case I
Depth of contact less than "d" hence triangular stress prism.
f_c
x
Case II
Depth of contact equals "d" hence trapezoidal stress prism.
f_c
b
x
f_o

Fig. 2. **Stress prisms in masonry support caused by two different cases of loading.**

Example—Given a standard 15-in. 60.8-lb. I-beam with a span of 20 ft. c. to c. of columns and supporting a uniform load (including its own weight) of 40,000 lb. The concrete columns are 8x12 in. by 12 ft. high, and the beam extends to the outside edges. Assume an allowable f_c of 500 lb. per sq. in. Required: the width b, of the base plate.

$$x = \frac{15{,}000 \times 12 \times 609.0}{40{,}000 \times 20^2} = 6.94 \text{ in.}$$

This value of x being less than 8 in., the example falls under Case I.

$$b = \frac{2 \times 20{,}000}{6.94 \times 500} = 11.55 \text{ in.}$$

An 8 x 12-in. base plate thus would be required whereas by the customary method the width would be given as

$$b = \frac{20{,}000}{500 \times 8} = 5 \text{ in.}$$

This is seen to be less than 50 per cent of the width given by the proposed method, and in practice it doubtless would be increased arbitrarily.

The above analysis applies only to a simply-supported, uniformily-loaded steel beam, resting on top of a column or pedestal having a cross-sectional area equal to that of the base plate. Other equations applicable to any type of beam, under any condition of loading, and resting on any type of support, may be derived in a similar manner. In order not to obscure the main issue which lies in the mechanics of the contact between base plate and masonry, the analysis has been confined purposely to the simplest type of support. Any difference between the equations derived above and those that would result from other types of support would rest entirely in the difference between the cubical contents of the assumed stress solids. If the cross-sectional area of the support is greater than that of the base plate, the stress prism takes the form of a truncated pyramid having as many sides as the base plate. In the case of a wall support, for example, the results, as obtained by means of the above equation, would be in error on the side of strength. For accurate results, it would be necessary to set up a special equation based on a truncated pyramid of stress having one vertical side.

Special Building Permit Surveys

Bureau of Labor Statistics issues first two of a series of reports devoted to specific cities

In the seven-year period, 1929-35, Toledo, Ohio, issued permits for structures providing 1822 family-dwelling units, 65 per cent of which were charged to 1929. In the same period, Memphis, Tenn., issued permits for 2,484 family units, 45 per cent of which were in 1929 and 32 per cent in 1930. These figures are found in the first two of a series of reports to be made by the division of construction and public employment of the U. S. Bureau of Labor Statistics, presenting a detailed analysis of building permits issued in selected cities with a population of 10,000 or more. Data for the 7-year period are broken down by type of structure, exterior material, cost, number of rooms, average cubic content, etc.

The first reports show that in Toledo, for example, 53 per cent of the 1,822 units provided in structures for which permits were issued had an estimated cost (exclusive of land) ranging from \$3,000 to \$5,000; 19 per cent cost from \$1,000 to \$3,000. In Memphis, on the other hand, 46 per cent of the units cost less than \$1,500. About 70 per cent of the units in both cities were in one-family detached structures; for these, wood was the predominant exterior material. For structures providing for five or more families in Toledo most structures were of reinforced concrete with brick facing, while in Memphis these apartment houses were about equally divided between brick and brick veneer construction.

Other interesting figures relate to the average cost per unit. In Toledo, for one-family frame structures, the range was from \$3,857 in 1929 to \$2,417 in 1934 while in brick veneer the range was from \$9,027 in 1929 to \$5,865 in 1931. Comparable figures for Memphis for frame, one-family, detached structures were \$1,221 in 1929 and \$545 in 1934.

The depth to which the building industry plunged during the depression years is evident from the figures quoted at the beginning of this article. Other data in the reports supplement these figures strikingly. For example, in Toledo, 306 more family units were demolished than were built in the 1931-35 period. Memphis did somewhat better although 50 more structures were demolished in 1934 and 60 more in 1935 than were built in those years. A conclusion in the Toledo and Memphis reports is that "new construction serves primarily to meet increasing demand rather than to replace obsolete or unfavorably situated structures, while demolition activity represents efforts to remove tax-eating structures during periods when demand is light."

It is stated that reports on other cities will soon be released.

FROM FIELD AND OFFICE

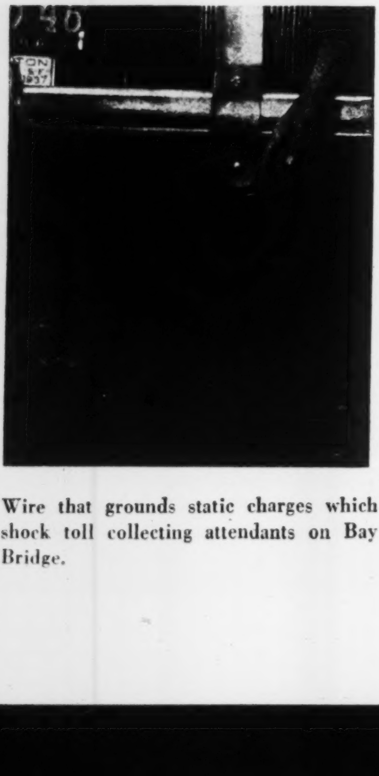
Working problems and time-saving methods . . . Edited by Charles S. Hill

"Cat's Whisker" Static Dissipater

Means of discharging static electricity from automobiles approching toll gates on the San Francisco Bay bridge has been found necessary. Cars traveling rapidly across the bridge accumulate on the steel frame a static charge of sufficiently high potential to cause an electric spark and accompanying shock when finger tips of the motorist touch those of the toll collector. Preventing this by the so-called "squirt" method (a small salt water stream) such as that installed on the Triborough Bridge at New York was considered but the device finally selected and installed on the Bay bridge is a vertical wire or "cat's whisker" mounted in the pavement.

The mounting is a coil spring bolted in a slot 4 in long and 1x2 in. in cross-section set in the pavement in the middle of each traffic lane a few feet ahead of the toll gate. The whisker is a No. 18 steel piano wire projecting 14 in. above the pavement surface; the lower end of the wire is well grounded. The undercarriage of a car approaching the toll gate strikes this wire which grounds and thus dissipates the static charge.

The design is not ideal, it is said, because small wires have to be used and these wear rapidly. Occasionally they are broken by motorcycles or by the wheels of cars that get out of the prescribed lanes. Daily inspection of the wires is required, and replacements are made every few days.



Wire that grounds static charges which shock toll collecting attendants on Bay Bridge.

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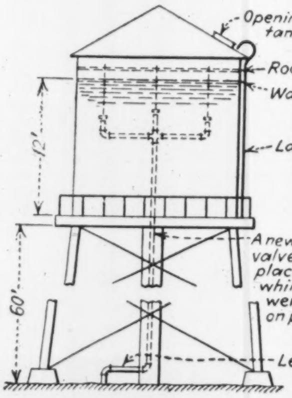
Repair of Pipe Leak in Elevated Tank

by R. BOETTINGER
Englewood, N. J.

A successful method of making a pipe replacement necessitated by a leak in the circulating system for winter-time heating of the water in an elevated tank is shown by the accompanying sketch.


Opening to tank
Root deck
Water level
Ladder
12'
60'
A new shut-off valve was placed here while repairs were made on pipe below
Leak here

Flush tank balls cut off water for repairing a pipe leak.

There was no way of shutting off the circulating line immediately under the tank, so that repairs could be made, without draining about 25,000 gal. of water out of the tank to bring the level down to the tops of the circulating branches. To avoid this, three holes were cut in the roof deck inside the tank directly over the three open ends of the circulating risers. Toilet flush-tank balls to which weights were attached were lowered and allowed to rest on top of the three openings as shown in the sketch. After these were in place, the covering from the leaking pipe was removed as far as the elbow. The elbow was then smashed with a hammer. The sudden rush of water down the circulating line pulled the flush tank balls tightly into the openings and effectively closed off the water. Repairs were then an easy matter and the efficiency of the sprinkler system of which the tank was a part was unimpaired.

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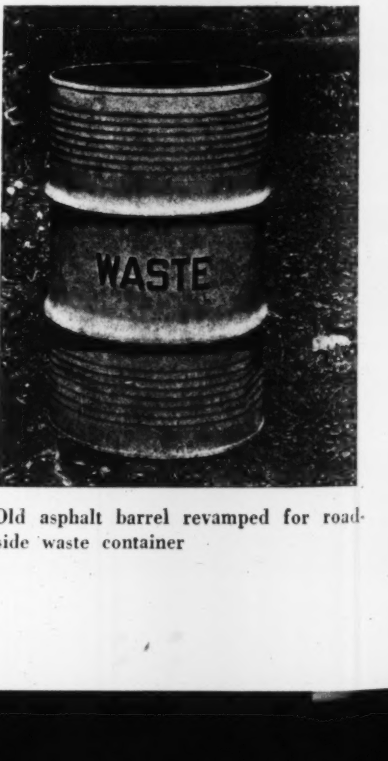
Roadside Waste Receptacle

by W. W. STIFFLER
Assistant Maintenance Engineer, Oregon State Highway Department, Salem, Ore.

The maintenance division of the Oregon state highway department has converted old iron barrels which have passed their useful period for storing road oil or asphalt to a very useful purpose. All old barrels which still retain their original shape and lines are first burned and cleaned of all asphalt, then painted the standard traffic yellow, with the word waste stenciled in black lettering, and used as receptacles for waste and rubbish.

These containers are placed at various locations: Permanent intersections; adjacent to school houses; at all areas where the roadbed has been widened to allow motorists to park their vehicles; at or near drinking fountains, and at prominent vistas or view points where motorists frequently elect to rest a short time either in eating lunch or fruit between meals. They have contributed considerably toward keeping the



Old asphalt barrel revamped for roadside waste container

highways free of waste papers and pamphlets, lunch containers and various refuse.

These receptacles are periodically emptied and cleaned by the section maintenance forces in conjunction with their regular duties which require the general policing and cleanup of all rubbish, trash and refuse from all state highways. Standard instructions require attention to this feature of maintenance by all section crews, one day each week.

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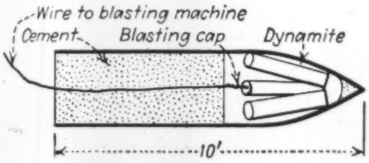
Gravel Cleaned by Bombing

by F. R. Cozzens
Stockport, Ohio

The average estimated cost of cleaning gravel for highway construction is 3c. per cubic yard. In many inland waters, this cost is being reduced from one-third to one-half by a water bomb, made up on the job by the workers themselves.



Job-built bomb loosens gravel bed for current actions on mud.

The bomb is built from a 10-ft. section of iron pipe, 4 in. in diameter, and with four gores cut in the bottom which are welded into a point. Into the point of this pipe are loaded three 1½ × 8-in. cartridges of ammonia dynamite, 40 per cent strength, extra L.F. An electric blasting cap (No. 6 size) is then connected to the center or priming cartridge, and the cap wire (insulated) is passed up and out through the top of the pipe. A small amount of paper or asbestos wadding is placed over the cartridges, and the pipe is poured full of cement.

The bomb is put into use by dropping it, point down, from a barge into the gravel bed; from three to ten bombs are thus planted at one operation. The wires are then hooked together in a series, and the bombs are fired by a blasting machine. The action of the blast lifts the gravel from its bed, allowing free circulation of water, and water agitation frees the gravel from mud and silt; in 90 per cent of cases no further cleaning is necessary. The average cost of constructing a bomb is $1.

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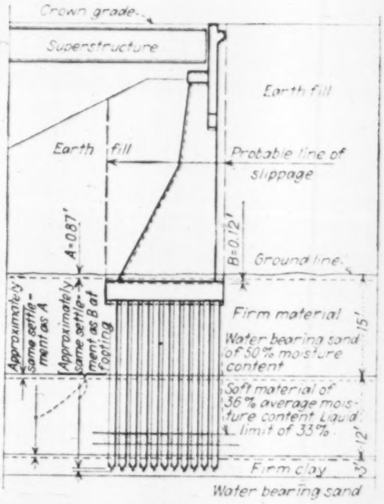
Abutment Settlement Studied by Soil Mechanics

by LaMotte Grover
Office Bridge Engineer, State Highway Commission, Topeka, Kansas

The manner in which a small foundation construction may benefit from the new knowledge embodied in the science of soil mechanics and from a generally more modern approach to soil problems has been demonstrated on a recent bridge job in Kansas. A settlement of 0.21 ft. and a backward tilting of about 0.1 ft. on one of the abutments of a new viaduct in the town of Norton afforded the opportunity. The abutments are of open or skeleton type founded on piles and buried in 26- and 30-ft. fills.

The settlement at the one abutment suggested that the entire area under and adjacent to the approach fill might likewise have settled. To investigate this condition, plates were buried at various elevations below ground in the vicinity of the other abutment before the earthfill was placed around it, and soundings were made to determine the nature of the underlying material. The first 15 ft. below natural ground elevation was quite firm. Then a 12-ft. stratum of rather soft material was encountered with an average of 36 percent moisture, whereas the liquid limit of this material was found to be only about 33 percent. The elevations that were read on the plates together with the properties determined for the soil that was taken from the soft stratum indicated that, in a case of this kind where unusual moisture conditions may be expected, the true bearing power of the soil under a superimposed load such as that of an earthfill can be accurately predicted by applying the principles of soil mechanics.

Periodical observations during and after the placing of the earthfill showed that a plate set at the surface of the ground settled the same amount as one placed 15 ft. below surface at the bottom of the firm stratum. The total settlement of the ground surface was 0.87 ft., while that of the abutment and piling was only 0.11 ft. at the abutment where the investigation was conducted. This indicated that there was no appreciable compaction in the 15-ft. firm stratum that was theoretically capable of sustaining the load, and that the bond must have been broken between the abutment and earthfill outside the footing area.


Crown grade
Superstructure
Earth fill
Earth fill
Probable line of slippage
A=0.87'
B=0.12'
Ground line
Approximately same settlement as A
Approximately same settlement as B at footing
Firm material
Water bearing sand of 50% moisture content
15'
Soft material of 36% average moisture content. Liquid limit of 33%
12'
Firm clay
3'
Water bearing sand

Subsurface conditions at skeleton abutment which settled under the load of an earthfill

The evidence indicated that practically all the settlement was due to compaction of the 12-ft. stratum of 36 percent average moisture content, which contained a thin stratum of water bearing sand in which the moisture content ran as high as 50 percent.

The piling extended approximately to the bottom of a 3-ft. stratum of firm clay under the unstable 12-ft. stratum. Beneath this clay, water bearing sand was found. The piling had been driven to practical refusal without the aid of a jet.

Although the settlement of these abutments has apparently stopped and no serious trouble is anticipated for the future, it would be much more satisfactory, in a case of this kind, to gain a thorough understanding of the condition beforehand, and to specify piling driven with a jet to such a penetration into underlying firm strata, that settlement of the abutments would be precluded.

The special investigations of the foundation conditions were carried out for the Kansas state highway commission by C. O. Neilson, assistant division engineer, T. W. Hicks, resident engineer, and John S. Schafer, division materials engineer. The Omaha Steel Works Co. was the general contractor.

THE WEEK'S EVENTS

Continued from page 414

Disagreement Ends On Possum Kingdom

A long-standing stalemate which has held up construction of the Possum Kingdom Dam on the Brazos River in Texas was resolved last month by the allotment of $4,500,000 to the Brazos River Conservation and Reclamation District by the Works Progress Administration. The grant is conditioned upon either the award of a construction contract for the dam at not more than the sum allotted, or the assumption by the district of the additional cost above that amount, including the installation of electrical generating equipment.

The project has been in suspense for some time because of widely differing cost estimates. It was first alloted a grant of $3,100,000 based upon preliminary estimate by the district, and the Corps of Engineers was directed to supervise construction. Further study of foundation conditions resulted in a request that the grant be increased to $6,600,000, an amount that the district claimed is excessive. The President then directed the Bureau of Reclamation to make an independent estimate, and this was recently completed. The amount reported has not been made public, but it is believed that it approximates the $4,500,000 included in the revised allotment.

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Trans-Manhattan Tunnel Studied by Board

A general plan for the proposed tunnel under midtown Manhattan which would connect the new Lincoln Tunnel and the Queens-Midtown Tunnel, both now under construction, has been submitted to the New York City Board of Estimate by Borough President Levy.

The plan calls for twin tubes, one under 37th St. and the other under 38th St. Both would extend from Second Ave. to Tenth Ave., a distance of 6,300 ft. Cost of the project is estimated at about $30,000,000.

The tunnel will have to go as deep as 100 ft. underground, at Fifth Ave., to avoid interference with existing subsurface structures. Each tunnel is designed to carry a 30-ft. roadway handling three lanes of traffic, and it is estimated that the crosstown tube will accommodate 2,400 vehicles per hour in both directions. The plan includes an underground parking area for 6,000 cars and a bus terminal in the center of Manhattan.

Application has already been made to PWA for a loan and grant to finance construction. The Board of Estimate will give the matter further consideration Sept. 24.

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More Tracks to Be Removed From Buffalo Streets

The New York State Public Service Commission has ordered removal of the Terrace tracks of the New York Central Railroad in Buffalo, N. Y., ending nearly 50 years of effort to improve the lower downtown area. The total improvement is expected to run into several millions. Although the order definitely clears the way for removal of the tracks, it will probably be another year before detail plans can be approved and construction work can be started.

A number of large Buffalo construction projects are being made issues in the local primary campaign for the mayoralty. The candidate of the regular Democratic organization pledges himself to work for the elimination of the slum district and the inauguration of a housing construction program. The independent candidate pledges to work for the construction of the high level bridge to conect Erie St. with Fuhrman Boulevard, a $2,045,000 project.

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Additional Water Supply Planned for Houston

A field survey to determine the most feasible means of obtaining additional water supplies for the city of Houston is being made by the Chicago firm of Alvord, Burdick & Howson. The city contract with the engineering firm calls for a complete survey of the present underground water supply and the available surface supply.

The San Jacinto, Brazos, Trinity and Colorado Rivers will be studied and recommendations and estimates will be made for the choice of an approved source.

Surveys by city, state and federal engineers have shown that the present Houston deep well supply is inadequate.

COLONEL HORATIO B. HACKETT

Hackett Resigns from PWA

The resignation from the Public Works Administration of Col. Horatio B. Hackett, announced in these pages recently (*ENR*, Aug. 26, 1937, p. 333), marks the end of 3½ years' service with that agency. Colonel Hackett became general manager of the Emergency Housing Corp., a subsidiary unit of PWA, in February, 1934, becoming director of housing in June. He was appointed assistant administrator of PWA in May, 1935.

As to the future, the Colonel has made only one definite commitment: to referee the Rose Bowl football game on January 1, 1938. For the time being he intends to take his first relaxation in 3½ years. After he has recovered from the fatigue of directing an organization that received, at the peak, over 4,000 letters a day, he will start thinking about a future connection—preferably one in which he can get his boots muddy.

Colonel Hackett, who is now 57 years old, graduated in 1904 from West Point, later resigning from the army to become associated with T. H. Burnham & Co., architects of Chicago, as superintendent of building construction. In 1914 he became general superintendent of the Embree Iron Co.

At the start of the World War, Colonel Hackett was mustered into the service as a lieutenant-colonel in the Third Field Artillery of the Illinois National Guard, which later became the 124th Field Artillery and saw service in France. Colonel Hackett was promoted to colonel in 1918 and was decorated for gallantry in action.

After the war Colonel Hackett returned to civil employment as a partner in the firm of John Burnham & Co., investment securities, where he stayed until 1922 when he became a partner of Holabird & Root, Chicago architects.

DENVER FILTER PLANT OPENS

This is not a public library; it is the interior of Denver's new 57,000,000 gallons a day filter plant 3½ miles west of the city limit, which was dedicated August 20. The plant filters water from the western slope, giving Denver a supply from the Colorado River watershed.

The plant goes into operation at a time when all former consumption records have been broken and water use has risen to 127 m.g.d. For the past seven years irrigation restrictions have been necessary during the summer but this year all restrictions have been lifted.

Canal Contract Is Let For Heart Mountain

A contract covering construction of about 7½ miles of main canal of the Heart Mountain division of the Shoshone federal reclamation project has been awarded by the Bureau of Reclamation to James Crick of Spokane on his bid of $225,000. The successful bid was the lowest of five opened Aug. 2. In addition to canal excavation the contract covers construction of eleven culverts, a bridge, a concrete siphon and wasteway across North Cottonwood Creek and a similar structure across Cottonwood Creek.

The Shoshone project was undertaken more than 25 years ago. As planned it included five divisions, the Carillon, the Frannie, the Willwood, the Heart Mountain, and the Oregon Basin division. The first three of these divisions are in operation, the Heart Mountain is now under construction, and the Oregon Basin division has not yet been undertaken. In all, the project contemplates irrigation of 164,000 acres. The Heart Mountain Division will receive its water supply from the Shoshone reservoir, created by Shoshone Dam, as do all the divisions now operating. Additional storage would have to be developed if the Oregon Basin division were undertaken.

Work on the Heart Mountain division was started with an allotment of $1,300,000 from emergency funds, and Congress appropriated $700,000 for its continuation last year. This year Congress again appropriated $700,000 to carry the construction through the fiscal year 1938.

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Baton Rouge Bridge Gets Under Way

Construction of the $8,361,000 bridge across the Mississippi River just north of Baton Rouge, La. was inaugurated with official ceremonies last month.

The Baton Rouge bridge will include two cantilever spans each with horizontal clearances of 848 ft. and vertical clearances of 65 ft. The bridge will carry a single track railroad and two 18-ft. concrete roadways. These will form a link in a proposed 40-ft. road from the Mississippi line through New Orleans and Baton Rouge and on to northern Louisiana and southwest Louisiana.

The main structure of the bridge will be 3,326 ft. long, and 8,900-ft. approaches will give a total length of 12,226 ft. Ultimately, with connections to the state highway system and to the Louisiana and Arkansas and Missouri Pacific railroads, the bridge will cost about $9,000,000.

The Kansas City Bridge Co. is to build the six piers upon which the main bridge structure will be erected by the Bethlehem Steel Co. Construction is expected to take two years.

New Uses for Cotton To Be Studied

Development of new uses for cotton will be stimulated by an allotment of $100,000 earmarked by the Agricultural Adjustment Administration to provide cotton fabric or, if desired, raw cotton to federal and state governmental agencies, educational institutions and non-profit organizations for experimental purposes along certain specified lines. Included in the list are a number of uses of engineering interest, including the reinforcement of asphalt-lined irrigation ditches, stabilizing raw cuts and fills along highways, levees, revetments, and earth dams, the prevention of soil erosion and the reinforcement of road surfaces.

The AAA plan was initiated in March, 1937, with a small allotment, but little was done because of the short time intervening before the expiration of the fiscal year. This time, with the combination of an early start, a greatly increased allotment and an expanded list of potential uses, it is hoped that substantial results will be obtained in procuring basic data that will open up new markets for cotton.

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Several Bills Introduced On Mortgage Financing

Three bills introduced in the closing moments of the recent session of Congress aim at facilitating private financing of resident construction. A bill introduced by Senator Wagner of New York would expand the power of the Federal Housing Administration to enable it to issue mortgages on large apartment buildings constructed by private corporations. Under the proposed bill FHA would have a voice in fixing the rentals of these structures and could limit the dividends. The proposal would also permit mortgage insurance on small apartment houses built by individuals.

Another bill introduced by Representative Hancock and Senator LaFollette would also extend federal mortgage insurance provisions to private financing of multi-family housing groups for low-income families.

Senator Wagner also introduced a bill which would create a special committee of three Senators to conduct a study of the proposal to establish a federal mortgage bank, or otherwise provide for a permanent discount and purchase system for handling mortgages on urban real estate. The committee would be instructed to report the results of its findings and such recommendations as it might wish to make to Congress.

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

American Association of State Highway Officials, annual convention, Boston, Sept. 27-30.

American Public Works Association, annual conference, Atlanta, October 4-6.

American Public Health Association, annual meeting, New York, Oct. 5-8.

American Society of Civil Engineers, fall meeting, Boston, Oct. 6-8.

National Council of State Boards of Engineering Examiners, annual meeting, Scranton, Pa., Oct. 11-13.

National Safety Congress, Kansas City, Oct. 11-15.

American Welding Society, annual meeting and exposition, Atlantic City, N. J., Oct. 18-22.

Canadian Institute of Sewage and Sanitation, annual convention, London, Ont., Oct. 21-22.

American Institute of Steel Construction, annual convention, White Sulphur Springs, W. Va., Oct. 27-29.

REGIONAL AND LOCAL

Section Meetings American Water Works Associations New York, Schenectady, Sept. 30-Oct. 1; Rocky Mountain, Santa Fe, N. M., Sept. 20-22; Southwest, Austin, Texas, Oct. 18-21; California, Sacramento, Oct. 20-23; Minnesota, St. Paul, Oct. 28-30; Virginia, Richmond, Nov. 4-6; Missouri Valley, Omaha, Nebr., Nov. 4-6; Wisconsin, Green Bay, Nov. 8-10.

New England Water Works Association, annual convention, Poland Spring, Me., September 21-24.

Rocky Mountain Sewage Works Association, first annual meeting, Santa Fe, N. M., Sept 20-23.

Texas Public Health Association, annual meeting, Dallas, Texas, Nov.

ELECTIONS AND ACTIVITIES

The Three Months Old Engineers Club of Sioux City has begun a membership drive which will continue until the first of next year. The club now has a membership of 60 and has set 150 members as its goal. Officers of the club are C. W. Kline, president; R. F. Burkhart, vice-president; C. E. Langton, secretary; and J. S. McDonald, treasurer.

J. R. Gilchrist was elected president of the South Carolina Water Works Association at its Charleston Convention Aug. 25-26. J. M. Garrison was elected vice-president and B. P. Rice was re-elected secretary. An illustrated talk by James E. Gibson of the Charleston water works on the new 23-mile Edisto River Tunnel was followed by a visit to the works. Papers presented included: "Danger and Emergency Treatment of Chlorine and Ammonia Gas," by Dr. H. F. Wilson, "Aeration of Well Water for Removal of Carbon Dioxide," by F. K. Ellis, "Reforestation for Control of Soil Erosion," by W. C. Hammerle, and "Laboratory Control of Water Purification," by J. D. Leslie.

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License Examination

Iowa: Examinations for professional engineering, Sept. 21-22 and for land surveying, Sept. 23, in the Senate Chamber at the State House, Des Moines, Iowa.

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Air Cooling Water-Use Worries Memphis

Mayor Overton of Memphis is seeking a survey to determine what danger, if any, of a possible water shortage arises from the increasing use of water in the air conditioning units in the city. The mayor indicated that, if necessary, he would appoint a commission with power to regulate such use of water and to protect the city's underground supply.

Thomas Allen, chairman of the Memphis Light and Water Division, is of the opinion that the only effect the lowering of the water table would have at the present time is the added cost of pumping, but that there was danger of overloading the city's sewerage system.

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Engineer Delegates Sent To Poland

V. M. Spunar and A. Kawecki will represent the Polish Engineers Association at the Congress of Polish Engineers which will convene Sept. 12-17 at Lwow, Poland.

The Congress will be a gathering of Polish engineers and engineers of Polish extraction from all parts of the world. Concurrently with the congress, the 60th anniversary of the Polytechnical Society of Poland will be celebrated. After the congress adjourns, the delegates will split into two groups, one of which will go to Paris to attend the exposition and the other will remain in Lwow to take part in the fair there.

PERSONAL

Ralph Cosenza and Morris Liebeskind who were formerly connected with the Thompson-Starrett Co., have opened offices in New York City to practice consulting engineering, specializing in the design and inspection of structures.

Charles G. Gonter, for 8 years traffic engineer of St. Louis, has resigned to take a position with a commercial firm interested in the scientific development of vehicle traffic control on a national scale. It is stated that Mr. Gonter does not wish to make public at this time his new connection. Mr. Gonter began work for the city in 1924 as a lighting engineer in the department of public utilities but soon shifted into traffic engineering work.

J. N. Bradford, engineer in charge of the material testing laboratory of the Birmingham division of the Alabama state highway department, has resigned to accept a position with the National Cement Co. of Atlanta.

Thomas J. Skinner, for the past ten years division engineer in charge of the distribution section of the St. Louis, Mo. water department, and Frank Kriz of the civil engineering division of the board of public service there, have been ordered to exchange positions. The change was made, according to Mayor Dickmann, for the sake of harmony. The positions carry the same salary.

Joseph J. Feuchter, superintendent of maintenance and construction in the traffic section of the St. Louis department of streets, has been given a temporary appointment as city traffic engineer. Mr. Feuchter has been in the city service for the past four years; earlier he was associated for ten years in private engineering work with Frank J. McDevitt.

Richard Dieckhaus, a civil draftsman in the St. Louis street department, has been appointed superintendent of maintenance and construction.

J. Stevens Ronay, structural steel designer of Lakewood, Ohio, has become associated with the Tata Iron & Steel Co. Ltd., of Jamshedpur, India. He was formerly with Republic Steel.

Jean Bastien has been made chief division engineer of the Quebec department of roads.

M. P. Anderson, formerly with the contractors for Grand Coulee dam, is now chief engineer for Brown & Root, Inc. and McKenzie Construction Co., of Austin, Texas, contractors for Marshall Ford Dam.

Roger A. Smith, formerly connected with the U. S. Engineers at Pittsburgh, is now with the H. K. Ferguson Co., at Port Alleghany, Pa.

Abel Wolman, whose appointment as professor of sanitary engineering at Johns Hopkins University was recently announced, resigned Sept. 1 as public works administrator for Maryland and Delaware, to take up his new work. He continues, however, as chairman of the National Water Resources Committee.

George L. Burke has been appointed assistant to the Connecticut state director of public works. He is in charge of the highway division, covering planning, construction, inspection and supervision of all work involving sums in excess of $1,000 done by the state highway department. Mr. Burke was formerly chief engineer of the Works Progress Administration in Connecticut.

Linton E. Grinter recently joined the staff of Armour Institute of Technology at Chicago as director of civil engineering and dean of the graduate division. Dr. Grinter was previously professor of structural engineering at Texas Agricultural and Mechanical College.

Harold R. Flint, district engineer at Pocatello for the Idaho state highway department, has resigned after 18 years with the department to take an unnamed position with a private corporation.

Ross White, who had charge of the construction of Norris Dam for the TVA, has resigned from the Authority to become general manager for Brown & Root, Inc. and McKenzie Construction Co., contractors for Marshall Ford Dam on the Colorado River near Austin, Texas.

John H. Lewis, formerly state engineer of Oregon and now a member of the Portland Dock Commission, has been appointed engineer for the newly established Cascade Locks Port District which is in Hood River County, Oregon.

Charles L. Patterson, who has done special work for the Colorado state engineers office in the past few months, has been appointed head of a special engineering department newly created by the Water Conservation Board at Denver.

Leonard M. Sandston has been appointed superintendent-engineer of the Pittsburgh health department's sanitation bureau, succeeding George W. Schusler who was dismissed some weeks ago. Mr. Sandston has been attached in an engineering capacity to the highway and sewers bureau of the city works department.

Francis L. Brown has been appointed county superintendent of highways of Washington county, New York. He was previously resident engineer-inspector for PWA on projects in western New York state.

Edward L. Winslow, who has been in charge of the dam and reservoir section of the U. S. Engineer office at Zanesville, Ohio, has resigned that position to do flood control work for the Pennsylvania department of flood control and forestation.

Nelson G. Fasnacht will succeed Edward L. Winslow in the dam and reservoir section of the Zanesville U. S. Engineer office.

Capt. N. A. Matthias has taken up his duties as military assistant to the district engineer of the Los Angeles engineer district. Captain Matthias was previously an instructor at the U. S. Military Academy at West Point.

H. Austill has been appointed chief engineer of the Mobile & Ohio R. R. Co. with offices at St. Louis.

Hugh Miller has opened an office in Charleston, W. Va. to practice engineering, architecture, landscape architecture, and town, city and industrial planning, under the name of Hugh Miller Associates.

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Utility Concern Drops Holding Companies

In an action marking the first capitulation of a major utility to the "death sentence" section of the Public Utility Holding Company Act of 1935, the American Water Works & Electric Co. has submitted to the securities and Exchange Commission a voluntary plan to simplify its system to meet the provisions of that section by eliminating all sub-holding companies. The company controls electric and gas properties in five eastern states and also has 89 water companies in 21 states and in Canada.

Among other proposals the plan includes dissolution of the $75,000,000 West Penn Electric Co., the largest intermediate holding company. Subsidiaries of the West Penn will become direct subsidiaries of the parent corporation. Also dissolved would be Monongahela West Penn Public Service Co., Potomac Edison Co., and West Penn Railway Co.

OBITUARY

Elmer E. Farnham, superintendent of the Sharon, Mass., water works since 1887, died Aug. 24 at the age of 75.

Charles K. McQueety, 70, resident engineer for the Louisville & Jeffersonville Bridge & Railway Co. died Aug. 22 in Louisville. Mr. McQueety was an assistant engineer on the construction of the original Big Four Bridge across the Ohio River at Louisville.

Patrick Rich, of Rich Bros. Construction Co., Boston, who has been active in connection with the building of the Quabbin Dam of the metropolitan power and water supply system in Massachusetts, died Aug. 24 at Ware, Mass., aged 67. Mr. Rich had been in the construction business in this country for about 35 years.

John T. Frantz, 56, assistant manager of the building department of the Consolidated Engineering Co., of Baltimore, connected with that firm for the past 20 years, died in Baltimore Aug. 29. Mr. Frantz was supervising engineer on the construction of the Baltimore war memorial, the chemistry and physics buildings of Johns Hopkins University and on a number of the structures for Johns Hopkins Medical School.

John A. Crook, president since 1917 of the Denver Steel & Iron Works Co. and also president of the Monarch Engineering Co. of Falls City, Nebr., died recently in Omaha. Mr. Crook studied civil engineering in the Nebraska State University and was then employed for three years by the Canton Bridge Co. In 1900 he became chief engineer and secretary of the John Gilligan Co. He had also served as city and county engineer for various Nebraska communities.

Claude C. Donahue, a highway contractor active in New York state since 1910 and president of the New York highway chapter of the Associated General Contractors, died in Albany Aug. 16, at the age of 51. From 1914 to 1927, Mr. Donahue was a principal in the firm of F. D. Van Wagenen, Inc., after which he organized and headed the firm of Claude C. Donahue, Inc. Before he entered contracting work in 1910 he had been an instructor in schools and was for several years connected with the Brooklyn Navy Yard in an engineering capacity. His recent election as president of the New York state highway chapter marked the culmination of many years of service in that organization as chairman of important committees and as director and vice-president.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

VILLAGE WATER SUPPLY, NEW JERSEY

OWNER: Borough of Mendham, New Jersey; Clyde Potts, Consulting Engineer, New York City.

PROJECT: Furnishing materials and constructing improvements to water supply for borough of Mendham, N. J., as per tabulation below.

BIDS: Nine bids were opened June, 1937, ranging from a low of $13.666 to a high of $20.184, with completion scheduled for three months after contract, and all materials required for the construction to be furnished by the contractor. This is a regular municipal project, without WPA or PWA aid.

LOW BIDDERS:

1. F. N. Lewis & Co., Bloomfield, N. J.	$13.666
2. J. P. Burns, Dumont, N. J.	13.962
3. New York Sewage Disposal Co., New York, N. Y.	14.971

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Earth excav. struct	550 c. y.	$0.65	$1.00	$1.25
2. Earth excav. pipe lines	1,300 c. y.	.65	1.00	1.25
3. Clearing, aux. supply line	15 M. s. f.	12.00	5.00	1.25
4. Masonry, rock excav	50 c. y.	6.00	5.00	7.50
5. Fence removal	l. s.	50.00	30.00	25.00
6. Lumber, fdt. bracing, etc.	5 m. b. m.	75.00	10.00	75.00
7. Concrete, cl. A, 1:2:4	200 c. y.	17.50	22.00	20.00
8. Concrete, cl. B, 1:3:5	20 c. y.	15.00	15.00	18.00
9. Reinforcing steel	16,000 lb.	.065	.07	.06
10. Vitrified pipe, 4 in	158 l. f.	.50	.50	.22
11. Vitrified pipe, 6 in	18 l. f.	.60	.75	.375
12. Vitrified pipe, 8 in	26 l. f.	.75	.75	.62
13. Filter sand	170 c. y.	3.50	3.00	3.40
14. Filter gravel	55 c. y.	4.00	3.00	5.00
15. Misc. metal work	l. s.	50.00	75.00	30.00
16. Gate valves, 4 in	3 ea.	25.00	25.00	28.00
17. Gate valves, 6 in	4 ea.	35.00	35.00	45.00
18. Gate valves, 8 in	2 ea.	50.00	50.00	60.00
19. C. I. pipe, 4 in	100 l. f.	.85	.80	.90
20. C. I. pipe, 6 in	120 l. f.	1.20	1.25	1.25
21. C. I. pipe, 8 in	2,800 l. f.	1.75	1.50	1.65
22. C. I. pipe specials	2 ton	150.00	130.00	180.00

SHIELD TUNNEL, DETROIT

OWNER: Department of Public Works, Detroit; L. G. Lenhardt, Commissioner.

PROJECT: Driving of 5.622 ft. of intercepting sewer tunnel, 12.75 ft. inside diameter, by the shield method and building a 208-ft. section by open cut for Oakwood Interceptor from sewage plant grit chambers to Lonyo Outlet Sewer; last link in $22.000.000 intercepting sewer and treatment works project. The tunnel walls are two-pieces: primary lining of 16-in. precast blocks, secondary lining of 16-in. monolithic concrete.

CONDITIONS: Soft blue clay entire length. Two open-cut sections required at short radius turns impossible to drive by shield. Completion scheduled for June, 1938. PWA labor regulations govern. Minimum wages stipulated for every class of labor; varies from 75c. for common labor to $1.55 for skilled; most skilled trades listed at $1.50; muckers at $1.05 and miners at $1.30.

BIDS: Two bids only were submitted at opening in July, 1937. Contract was awarded to low bidder.

BIDDERS:

1. S. A. Healy Co., Chicago (contract)	$ 849,482
2. Blanck & Gargaro Co., Inc., Detroit	1,164,963

Item	Quan.	Unit Prices (1)	(2)
1. Tunnel sewer, 12.75 ft	5,622 l. f.	$131.00	$170.00
2. Open cut sewer, Flora-Reisener	l. s.	40,000.00	72,500.00
3. Open cut sewer, Flora-Forman	l. s.	38,000.00	65,500.00
4. Open cut sewer, Miller-Fort	50 l. f.	240.00	892.00
5. Standard manholes	9 ea.	200.00	500.00
6. V. c. sewer lining	25 l. f.	35.00	52.50
7. Opening, 6 ft	l. s.	250.00	200.00
8. Bulkhead, grit chamber	l. s.	500.00	300.00
9. Bulkhead, regulator chamber	l. s.	500.00	300.00
10. Install, remove compressor plant	l. s.	5,000.00	5,000.00
11. Build, remove air locks	3 ea.	1,500.00	2,900.00
12. Engineer's field office	l. s.	5,000.00	5,500.00
13. Test cores	31 ea.	75.00	60.00
14. Alignment holes	250 l. f.	7.00	5.00
15. Regulator connection	2 ea.	250.00	200.00

WATER MAIN EXTENSION, MICH.

OWNER: City of Marysville, Mich.; Pate & Hirn, Detroit engineers.

PROJECT: Construction of 9,000 ft. of 6 to 16-in. cast iron pipe for watermain extension in Marysville, Mich., specified trench cover is 5 ft. Underground utility conduit will be encountered along 500 ft. of 8-in. main; three railroad crossings are to be provided for; and 200 or 300 ft. of excavation will be in wet sand requiring pumping.

BIDS: Fourteen bids were opened, and contract awarded, in June, 1937, ranging from the low of $20,302 to a high of $36.459, with no contract completion time scheduled, and the owner furnishing 800 ft. of 16-in. main.

LOW BIDDERS:

1. Brandon Reed Co., Detroit, Mich. (contract)	$20.302
2. W. L. Johnson, Toledo, Ohio	20.746
3. Ray D. Baker, Detroit, Mich.	21.594

Item	Quan.	Unit Prices (1)	(2)	(3)
1. C. I. watermain, 6 in	150 l. f.	$1.45	$1.76	$1.45
2. C. I. watermain, 8 in	7,520 l. f.	1.67	1.78	1.83
3. C. I. watermain, 10 in	70 l. f.	2.80	2.29	2.42
4. C. I. watermain, 16 in	950 l. f.	4.35	4.04	4.28
5. C. I. watermain, 16 in., lay	800 l. f.	.95	.95	1.11
6. Fittings, 6 in	300 lb.	.07	.07	.06
7. Fittings, 8 in	4,200 lb.	.07	.07	.06
8. Fittings, 10 in	800 lb.	.07	.07	.06
9. Fittings, 16 in	2,700 lb.	.07	.07	.06
10. Valves, 6 in	12 ea.	25.00	25.00	26.00
11. Valves, 8 in	8 ea.	38.50	40.00	40.00
12. Valves, 16 in	1 ea.	225.00	165.00	165.00
13. Valve box	20 ea.	4.50	5.00	5.00
14. Hydrants, AWWA	11 ea.	77.00	75.00	90.00
15. Water services	12 ea.	4.00	3.00	2.00
16. House services	100 l. f.	.60	.50	1.00

SMALL IRRIGATION WORKS, NEBR.

OWNER: Central Nebraska Public Power & Irrigation Dist., Hastings, Nebr.; G. E. Johnson, chief engineer.

PROJECT: Construction of all main and small laterals with appurtenant drops, checks, flumes, culverts and turnouts in Group 32 of the District project west of Holdredge, Nebr.

CONDITIONS: Contract time is 100 working days. Wage rates up to 90c. per hr. for skilled, 50 to 60c. for semi-skilled, and 40c. for common. Access by rail and highway. The concrete yardage is spread over lots of territory; some places amount is only half a cu. yd.

BIDS: Opened Aug. 4, 1937. Proposals taken on thirteen subdivisions, one of which is for lateral excavation, six are for various control works built of concrete and six are

(*Contract Unit Prices continued on second following page*)